Vol. 1—6

PAVING AND MUNICIPAL ENGINEERING.

A Journal Devoted Specially to Street and Sidewalk Paving, Water Works Construction, Bridge Building, Street Lighting, Sewerage and all Matters Pertaining to Public Improvement in Cities.

ONE DOLLAR A YEAR IN ADVANCE. INDIANAPOLIS, IND., NOVEMBER, 1890. SINGLE COPIES, TEN CENTS.

J. E. RILEY, PRES., Omaha, Neb. C. W. HUBBARD, SEC., Sioux Falls, S. D. F. W. LITTLE, TREAS., Sioux City, Ia. A. D. TINSLEY, AUD., Sioux Falls, S. D.

THE

SIOUX FALLS GRANITE COMPANY LIMITED.

CAPITAL, $250,000

PAVING BLOCKS

Quarry and Works, Sioux Falls, South Dakota.

C. W. HUBBARD, GENERAL MANAGER.

Sioux Falls Granite

HAS AN ESTABLISHED REPUTATION as a FIRST-CLASS PAVING STONE FOR THE HEAVIEST TRAFFIC. IT HAS BEEN EXTENSIVELY USED in all the LARGER WESTERN CITIES with ENTIRE SATISFACTION. **180,000 Square Yards** *of Sioux Falls Blocks have been laid in Chicago during the last four years for TRACK AND STREET WORK.*

☞ **This Company is operating one of the largest and most complete plants in the country, and can fill orders promptly. Present output, 40,000 blocks daily.**

General Office, SIOUX FALLS, SOUTH DAKOTA.
Omaha Office, 4 and 5 GRANITE BLOCK.
Chicago Office, 730 OPERA HOUSE BLOCK.

..... FOR SALE .....

A Holly Pumping Engine

Capacity, 1,500,000 Gallons.

Size of steam cylinder, 10 inches; size of water cylinder, 7 1-2 inches; stroke, 21 inches; will pump against 250 feet head with the four pumps, and will lift from 23 to 25 feet; speed required for capacity stated about 23 revolutions. This engine is in good condition and will be sold at about half it would cost new.

Address, for particulars, Holly, care of

Paving • and • Municipal • Engineering

44 Chamber of Commerce, Indianapolis, Ind.

ASPHALT. ASPHALT.

THE BARBER

Asphalt Paving Co.

The Oldest and Largest

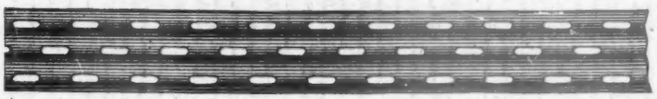
Asphalt Paving Company in the United States; has laid Asphalt pavements in twenty-seven cities of the Union, on 607 streets of a length of 255 miles, or an area of 3,916,574 square yards. It has laid more pavement in twelve years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

General Offices, No. 1 Broadway, New York.

LE DROIT BUILDING, WASHINGTON, D. C.

Our * Metallic * Lath

HAVE YOU USED IT?



If not, you will find it adapted to all kinds of surfaces. The best form of fire-proofing, most easily and cheaply applied. Leading architects specify it. Sample by mail.

The Cincinnati Corrugating Co.

POST-OFFICE BOX 321 PIQUA, OHIO.

To Paving Brick Manufacturers:

SANITARY PAVING BLOCK,

Vitrified Brick Asphalt Pavement

This Pavement is laid with Moulded Blocks, having nibs, or projections, for the purpose of uniformly spacing the blocks, thereby forming a uniform joint or space. This space can be filled with any good paving material. Address for particulars,

JOHN S. SCHAEFFER, Patentee,

No. 191 Littleton Avenue, Newark, New Jersey.

NOW READY FOR DELIVERY

THE LAW

—OF—

Roads and Streets

By BYRON K. ELLIOTT and WILLIAM F. ELLIOTT,

Authors of the Work of the Advocate.

Applicable to every City and State in the Union. Treats of the general principles of the Law of Roads and Streets. Does not deal with statutes, except in an incidental way, but discusses the general rules of law. Of the utmost importance to City Officials, Boards of Public Improvement, Contractors and all Corporations occupying Streets and Highways.

A Large 8vo. of over 800 Closely Printed Pages. Price, $6.00 Net.

THE BOWEN-MERRILL CO.

INDIANAPOLIS.

Mention this paper.

F. B. Dearinger. C. S. Niemier.

Dearinger & Niemier,

Floors for Warehouses, Cellars, Machine Shops, Sidewalks, Curbing, Etc. Also, Cisterns, Vats, Pipe and Brick Sewers.

Concrete Foundations,

Artificial Stone Contractors,

Portland and Keene's Cement Work.

No. 313 East Georgia St. Shop on Bates Street, between Liberty and Noble.

Indianapolis, Ind.

WITH GOOD PAVEMENTS

SHOULD GO GOOD WHEELS.

The BEST WHEELS are always BEST either on good or poor roads.

Columbia Cycles

HIGHEST GRADE ONLY.

CATALOGUE FREE.

BRANCH HOUSES:
12 Warren Street, New York.
291 Wabash Ave., Chicago.

POPE MFG. CO. 77 Franklin St., BOSTON. Factory, Hartford, Conn.

Warren-Scharf Asphalt

Paving Company,

CONTRACTORS FOR

PAVEMENTS

Of Genuine Trinidad Asphalt,

The Ideal Pavement of Modern Times.
No Longer an Experiment.
Experience has Established its Superiority

Over five millions square yards, equal to about 285 miles of street thirty feet wide, in successful use in over forty cities of the United States and Canada.
For full information and estimates apply to

WARREN-SCHARF ASPHALT PAVING CO.,

81 Fulton Street, New York,

or 23 BLYMYER BUILDING, CINCINNATI, OHIO.

A. H. PERKINS, President. W. D. HITCHCOCK, Vice-President. V. W. FOSTER, Sec'y & Treas.

THE WESTERN

PAVING and SUPPLY

COMPANY.

CONTRACTORS FOR

GENUINE TRINIDAD ASPHALT PAVEMENTS,

AND DEALERS IN

PAVING MATERIALS,

Room 7 Ingalls Block, INDIANAPOLIS.

OFFICE TELEPHONE 757.
S. H. SHEARER, Manager.

Yard & Works: Cor. Michigan & Indiana Ave.
TELEPHONE 380.

PRINCIPAL OFFICE, CHICAGO,
No. 8 The Rookery.

DETROIT OFFICE,
Cor. Jefferson Ave. and Griswold St.

GEO. MOERLEIN, Pres. JNO. GOETZ, JR., V. P. J. A. EBERHARDT, Sec. Treas. & G'l M'r

THE Southern Granite Company

Estimates for Architectural, Monumental and Street Paving Work will be promptly furnished.

OFFICES:

19 and 20 Wiggins Block, CINCINNATI, OHIO.
20 Kimball House, ATLANTA, GA.

ORIGINAL DESIGNERS
WOOD AND MAP ENGRAVERS
Wm A McCORD & CO.
160 VINE ST. NEAR 4TH CIN. O.

1878

AMERICAN CHAMPION.

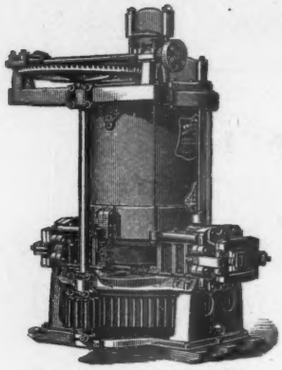
THE American • Road • Machine COMPANY,

OF KENNETT SQUARE, PENN., U. S. A.

1890

LIGHT STEEL CHAMPION.

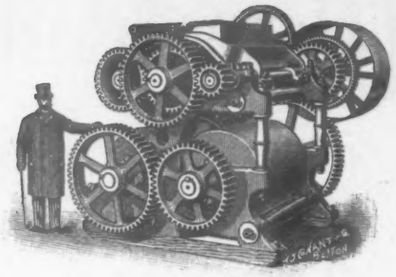
Are the oldest and largest manufacturers of Improved Road Machinery in the world. Their line embraces Road Machines ranging in price from $100 to $250. Road Rollers, all sizes, Rock Crushers, Wheel Scrapers, Drag Scrapers, Railroad and Grading Plows and Contractors' Carts. Their American Champion was awarded the silver medal at the Paris Exposition in 1889. Endorsed by L. W. Rundlett, C. E. of St. Paul, Minn.; Russell Thayer, C. E. of Fairmount Park, Philadelphia, Pa.; J. I. Case, owner of J. I. C., and many others whose judgment is regarded as authority. Their Steel Frame Light Champion is as enthusiastically endorsed by its users as being the best light draft Reversible Machine made. Their Champion Machines this season won 119 out of 155 competitive trials. All their machines are fully protected by letters patent and any machines other than their make employing HAND WHEEL LEVERS or SHIFTING HIND AXLE infringe their patents. One suit now pending against such an infringer—The Western Machine. All intending purchasers will do well to correspond with the American Road Machine Company before buying elsewhere. Catalogues, testimonials and prices on application.



No. "20 A" Brick Machine.

Plans and Improvements
For another year's run
Are now in season.
We have a suggestion:

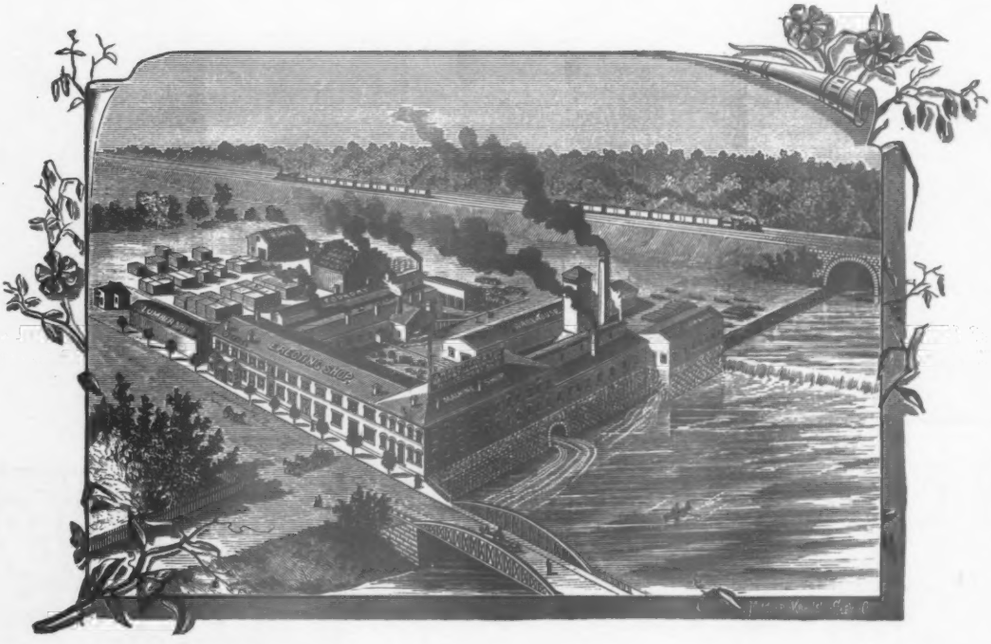
DON'T FORGET



No. 20 Compound Crusher.

To include in your list of improvements
What is a very important factor to the
Success of any brick-making plant, Namely—A full outfit of

The Penfield Brick Machinery



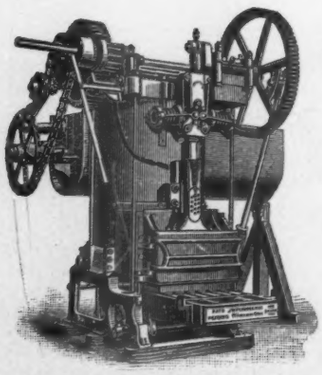
Stiff Clay

Machinery for Paving And Building Brick. Elevators, Hoisting Drums, Etc.

Upright

Stock Brick Machinery for Sand Mold Brick. Iron Dry Cars, Turn Tables, Etc.

PAVING * BRICK * OUTFITS * A * SPECIALTY



Upright Stock Brick Machine.

For full particulars address J. W. PENFIELD & SON,

WILLOUGHBY, O.

•• U. S. A. ••

No. 10 "D" Pug Mill.

PAVING AND MUNICIPAL ENGINEERING

VOL. 1. INDIANAPOLIS, IND., NOVEMBER, 1890. No. 6.

CONTENTS.

	PAGE.
The Paving Problem.....*James W. Howard, C. E.*	93
Some Modern Materials.....*W. L. S. Bayley, C. E.*	95
Experiments in Paving Brick.....*J. F. Fisher.*	96
Schedules of Water Rates.....*J. Nelson Tubbs.*	97
Hints to Country Roadmen	99
The Paving Brick Industry in Iowa	100
Book Notice	100
Personal	100
A Critique on Mr. Howard's "Paving Problem."..... *W. L. S. Bayley, C. E.*	100
"No Doubt of Our Success."	100
Editorial Notes	101

IMPROVEMENT AND CONTRACTING NEWS—

Paving	102
Sewerage	103
Water-works	104
Bridges	104
Street Lighting	105

THE PAVING PROBLEM.*

By James W. Howard, C. E.

IN 1816 Mr. James S. MacAdam was put in charge of the roads about Bristol, England. With his faculty of acute observation he effected great improvement and vast economy. Without professional training, he declared himself only a road maker. His system was simply to lay a stratum, ten to eleven inches thick, of small broken stone about two inches in diameter. While Mr. MacAdam deserves praise as a pioneer of road improvements, his system was soon shown to lack stability and economy. We too often repeat the experience of a century ago. We think that by spreading broken stone we have made a road. The underlying stones sink into the ground. From ignorance or laziness we go on adding stone on top. The expression "Macadam-road" is now used with a very general meaning. We can not now correct a popular usage. The expression can best be taken to mean a wearing surface of broken stone on a roadway. Please remember that the surface here spoken of as a Telford road is what the public might call a Macadam.

The engineer, Thomas Telford, began road building in 1803. He has left behind him hundreds of miles of solid Scotch Highland roads, also the broad highway from London to Liverpool, and the great North roads of England. The Telford road, called also the Telford-Macadam road, is made with a foundation and a wearing surface. The foundation is best made from rough, broken pieces of stone, six inches or more in size, set by hand on the prepared roadbed. Then the projecting stones can be broken off with a hammer and the chips placed between the foundation stones.

The wearing surface should be spread from four to eight inches thick upon the foundation, if within or near a city. It is simply crushed stone from 1 to 2½ inches in diameter. (Further details of rolling and repairing are out of place here.) The best kind of stone for the wearing surface of a Telford-Macadam road are: *First*, Dolerite (called also basalt and trap), which depends for its hardness upon the silica or quartz and the feldspar in it. Quartz is a valuable ingredient of all macadam stones, because it is so hard, has no true cleverage and breaks irregularly. *Second*, Syenite, a hard rock which often passes for granite. It is composed in the eastern portion of the United States, of quartz, feldspar and hornblend. It is the stone from which the obelisks are made. It composes the polished walls of the interior passages of the pyramids. *Third*, Granite, composed of quartz, feldspar and mica. *Fourth*, Limestones, few of them fit for macadam, because of the soft carbonate of lime of which they are composed. However, a form of calcite called compact limestone makes at first an excellent roadway. Because of its soft nature it is cheaper to crush at the quarry and cheaper to roll on the roadway. But the cost of repairing is frequent and great. Wheels, hoofs, air, water and frost combine against it. Do not use crushed limestone on a city street which has any traffic to speak of. To tell a limestone, fill a tumbler half full of hydrochloric acid, diluted with water. Pour into this a tablespoonful of the clean powdered stone. If it is a limestone a strong effervescence will take place. The carbonic acid gas is driven off. Limestone can well be used on village and suburban roads when the harder and better stone can not be had except at a very great cost. *Fifth*, Sandstone is useless for city streets and of doubtful value anywhere except on country roads. *Sixth*, Shales, slates and other stones whose base is alumina or clay. These are totally useless for macadam. In general, the harder the stone the better macadam it makes. It must not break in thin layers. If the stone is very hard, break it to about 1 inch to 1¼ inches in diameter. If it is limestone or soft, have the broken stone from 1½ to 2 inches in diameter.

Telford-Macadam roadways at best can only be used with pleasure and profit at certain seasons of the year. They soon become muddy, dusty and worn. People living upon them have great trouble in crossing and frequent crossing-stones impede all rapid driving. It is the costliest of all pavements if at all kept up.

Waterbury, Conn., with but 25,000 inhabitants, has engulfed in the last seven years about $50,000 in trying to keep up its gravel and macadam streets. Clogging of its sewers, caused by the mud from the streets, augmented a few years ago an epidemic of diphtheria. Finally, the city has learned that it is cheaper to issue bonds, pave with granite and asphalt, pay interest on the bonds, establish a sinking fund, and thus have better streets, drainage and health—and save money, too.

The city of Newark, N. J., is paying out yearly many thousands of dollars, because of the short-sighted policy of a previous generation, putting Telford-Macadam upon the street. The tendency was for property-holders to vote for this pavement because of its cheap first cost and there inflict upon the city the enormous expense of maintaining it. The maintenance often equals the cost of a new macadam every four or five years, where the traffic is constant, and the street kept in good order. Telford-Macadam is being steadily abolished from Newark, as from scores of other cities,

*The publication of Mr. Howard's paper began in the October number of PAVING AND MUNICIPAL ENGINEERING.

and the same money invested in real paved surfaces of stone and asphalt.

Turning to official records of London, we can judge of the expense of a macadamized roadway, and realize how the cost of maintenance is of far more importance than the cost of original construction. There are 1,127 miles of macadamized street surface within the city limits of London. The cost to maintain them in good order, as averaged from fourteen reports, was £291,750 ($1,414,987) per mile per year. This is £250 ($1,212) per mile per year. Within the inner city, subjected to heavy omnibus and numerous carriage traffic, besides some trucking, the cost of maintenance, from records extending from 1834 to 1870, on seven streets, has been 2 s 7¼ d (62½c) per square yard per year. On twelve streets, with a moderate city traffic, having a total surface of 72,329 square yards, the repairs have cost 14⅞ pence (29¾ cents) per square yard per year. On 123⅓ miles of macadam streets near the suburbs, with the lightest city traffic, the maintenance has absorbed £65,913 ($319,678), or £534½ ($2,592) per mile per year, or 7¼ pence (14½ cents) per square yard per year. Finally, the country roads of Islington Parish, which are used by the lightest, although continual, traffic of carriages, coaches and rural teams, cost for the whole 36 miles of roads, kept in good order, £8,424 ($40,826) per year. This is £234 (1,134) per mile, or 3⅛ pence (6¼ cents) per square yard per annum. Thus we see that where macadam is exposed to heavy or even moderate traffic on a city street, it soon becomes ruinously expensive.

Wood came first, superseding the macadam, and then gave way to asphalt, with which these streets of the inner city are gradually being repaired. This produces a vast saving of money, and it suppresses dust and mud. The enormous cost of cleaning and sprinkling are reduced to a minimum by the use of asphalt. Stone blocks are out of the question on certain London streets. The public will not tolerate the noise on these important thoroughfares.

Paris began to replace its macadam and some stone pavements with asphalt in 1854. It continues to steadily abolish macadam; nevertheless, it still pays almost $900,000 annually to repair the macadam now in use, and at the end of each year it must begin to spend the same amount again. The maintenance of macadam in Paris costs about 45 cents per square yard per year.

Boston spends about 50 cents per square yard per year on several of its macadam streets.

Berlin has abolished macadam and also wood. It has many well laid stone pavements, almost like floors. It has increased its asphalt, at about 12 per cent. each year for 17 years, until miles of it extend in many directions. This is done not only for comfort, but also to save money for repairs and cleaning, so costly under the old systems of pavements. Berlin is the cleanest city in Europe or America, and at the least cost per square yard.

Stone block pavements are of several kinds. Cobble or boulder stone pavements are not to be encouraged. They are a barbarous inheritance of a past age. They are not cheap in any way, shape nor manner, except as to first cost. Under a stone block pavement either a foundation of concrete, or a bed of gravel or sand, which have merit in the order named, are needed. The subsoil, after grading, should be well rolled before any kind of pavement is laid. Then put down the gravel or sand, if that is what is desired, and next the stone blocks, properly set and rammed. The best stone block pavement is of the class similar to that upon Fifth avenue, New York City. It consists of a six inch cement concrete foundation, then a very little sand. Upon this are placed the carefully cut *granite blocks*, about 12 by 4½ by 7 inches deep, set on edge crosswise the street, with joints carefully lapped or "broken." The spaces between the stones are filled with hot gravel and pitch.

The best paving blocks are of true *granite*. Then follow in value, as named, *syenite*, and a few other granitoid rocks, dolerite (called also basalt and trap), and one or two sandstones, which, however, are seldom to be relied upon to wear under more than light traffic.

Good sample specifications for standard pavements of all kinds can generally be obtained from all large cities. Get good specifications, written out in full. Have all pavements guaranteed for a term of years under a bond, or the retention of from 5 to 10 per cent. of the cost until the end of the guarantee period. This is now done in European and many American cities. Then see that the specifications are lived up to by the city and contractors. Property owners should attend to paving done in front of their property, as well as the building done upon it. They pay for both.

Engineering is often a knowledge of materials and methods, combined with common sense. The specifications for pavements describe the materials and their use. The average American citizen can add the required common sense.

The health of a city depends almost as much upon clean streets as upon an efficient sewerage system. Professor Tyndal shows that the mud of our streets is composed almost entirely of vegetable and animal compounds. Read the report of Dr. Raymond. We see the influence of absorbing pavements upon the spread and retention of yellow fever in 1878, when 12,000 people died. The dirt streets became putrid; the macadamized were the harbingers of disease germs, not only between the blocks, but also under them.

An impermiable pavement is the only truly sanitary pavement. All forms of pavement retain more or less dirt upon them for a shorter or longer period. It is simply a degree of cleanliness.

An impermiable foundation is the first essential. This can be made of cement concrete, *i. e.*, hydraulic cement, sand and broken stone, broken brick, broken slag, or even gravel, properly mixed when wet and laid from four to six inches in thickness. Or a bituminous foundation can be laid from four to six inches in thickness, according to the traffic on the street. This is one of the newest and most successful foundations for pavements, over bridges as well as streets. It consists of two or more layers of broken stone, cemented throughout with what is called paving pitch or "distillate," or "bituminous cement." There are also foundations of gravel and lime, but they take so long to set that the results are uncertain. The cheap foundations—if we can regard them as foundations—of gravel or sand are really nothing but a sort of filling to enable the paver to pose the paving blocks and secure an even upper surface with blocks of different depths. Upon the foundation of cement or bituminous concrete a thin layer of sand is next placed, if we are to have a wearing surface of stone blocks. Between the blocks hot, clean gravel and paving pitch prevent the absorption of noxious compounds. Every few years the joints should be cleaned out and new pitch poured in. This is the costliest, but most durable of all stone pavements, however it is the best adapted to streets for the heaviest trucking in the largest business cities. If the wearing surface is to be asphalt, it is laid directly upon the solid foundation and compressed. These two wearing surfaces, stone blocks and sheet asphalt, are the standard pavements of all the great cities of the civilized world.

All forms of block pavement, if placed upon earth, sand or gravel, no matter how well swept, always retain some filth. Every rain increases the objectionable percolation. This is impossible with an imperviable pavement. A rain not only cleans off the street, but also quickly washes out the sewers.

Recent microscopic examinations by Professor Ward, of Troy, tells us that the dust of our houses is the dust of the street. It is the carrier of many diseases, mitigated, however, by our fortunate frosts. We dread getting street mud on our clothing. But we breathe its emanations in wet weather, while in dry weather we breathe, as a dust, the very stuff itself. We have it on our bodies. We have it in our houses where it penetrates to every nook and corner.

Avoid a dust-retaining and dust-producing pavement. It is a tax upon health. Fortunately, also, the dust-producing pavement in form of macadam is the most expensive street surface which can be attempted. The constant renewals and the abundant and excessive sprinkling soon tax some one's purse beyond all endurance. The nervous strain under which we work also demands that where possible noise be suppressed.

Our noble Brooklyn bridge engineer, Col. Washington A. Roebling, said to me lately: "I would gladly pay a large share of the

cost of placing a noiseless pavement in front of my buildings. I am forced to avoid New York because of the din of the streets. A noiseless pavement," he continued, "is a good investment because the property rents more easily, especially the lower floors. Many a merchant, banker, broker, works with window closed in summer to keep out dust and noise. Ventilation is checked in houses, rich and poor."

Monsieur Tevernier, chief engineer of Paris streets, said last winter to me when I had called to get some statistics, that not only Paris, London, Berlin and Vienna, but also many smaller places have either asphalt or wood pavement about all their hospitals and most of their churches, schools, theaters, music halls, banks and government buildings. Custom has made this a necessity. I know of only two hospitals so blessed in the city of New York. During the hot summer of 1887 the noisy pavements about the city buildings in Chicago were covered with tan-bark, so that the trials could proceed with the windows open for air. How often do we see a noisy street covered with straw because a patient in a neighboring house is struggling for life. We need no longer look to Europe for quiet pavements, when for every quiet mile there we have more than three here, such has been the steady growth of smooth pavements.

SOME MODERN MATERIALS.

By W. L. S. Bayley, C. E.

EVEN the ordinary granites must go. While it may cause some surprise that we would relegate the standard granite of the fathers to second place, we insist that first, in order of merit, by every known standard weighed, comes the commercially pure silica from the northwestern states, generally called granite for business purposes, but truthfully quartzite is its name. All the members of this hard stone family are to be recognized as standing at the head of road material. As a paving block this stone is indigenous to Michigan, Minnesota and South Dakota, and stands pre-eminently over all other material. It is hard beyond the testing power of the government machines, while the fine iron of the shoe and the tire of the wheel are considered as tid-bits furnishing a daily lunch for the quartzite. It is as indestructible as the big, round earth itself. Fire will not consume it and water will not penetrate it. Its use in blocks for all commercial street traffic, as well as the more exposed parts of boulevards and drives, is universally commended, while as a fine macadamized wearing surface on a six-inch Telford base of softer stone, it is bonded by the finer crushings of itself with or without selenite cements or Portlands. We favor these bondings in the order named and know that the packing by its kind will not fail to give perfect satisfaction; while as much can not be said of foreign or impure admixtures, for, unlike gold, this material can not find and does not require an alloy. Briefly, the following important considerations demand the use of this material when good roads are wanted.

Cheapest in first cost.

No water and no frost.

No mud and no dust, and no receptacle for the poisons which ordinarily lodge in the crevices of wood and its associate materials.

Second to silica or quartzite, and subject to almost the same approved conditions, comes our very hard western granites, largely composed of that great staying element, silica. After this we accept a few eastern granites when our selections for wearing surfaces of streets and roads is exhausted.

Next in order come the asphalt combinations. This material is the most essentially climatic of all the paving devices offered. In the far west it is, where protected by proper specifications, and honestly laid down, seen at its best. The evenness of that climate goes very far to prevent the exudation of its essential oils by the extreme heat of the sun; neither can the frost king so successfully pursue his work of destruction in that favored clime. In the foundations of this material, as we have known them, we do not readily acquiesce; because natural cements are not, and can not be considered reliable until those cements have the same care in their manufacture as is now given to Portlands. At present, these natural cements are not to be safely used so near the hoof and wheel traffic of our streets. When it is remembered that we condemn the use of Portland cement in exposed places, we can not allow natural cements within four inches of wheel and hoof. We think that there is too free use of the word concrete; a word made by custom, generic with the use of Portland cement only, hence a misleading appellation when associated with cheaper materials. The day is past when experiments are permissible. To allow them in the broad light of the century just closing is to rob the municipality of funds which safe materials stand ready to absorb. True it is that all of these materials are sometimes good, but when valuable qualities depend so directly upon man's honesty, it goes without saying that the risk is too great for any advantages which can be claimed.

Next comes a new thing under the sun as applied to road making.

A friend of ours has a combination protected by letters patent, of Sioux Falls quartzite with Portland cement, nearly in the order of "1, 2, 3, 4." Granite and cement combinations have long been used for sidewalks and floors, but the extraordinary strength of hard stone, has emboldened the inventor to claim for it road-bearing qualities of a very superior nature. Our readers must judge for themselves whether this strictly non-elastic material can withstand the shocks to which, in its new service, it must be exposed. Candidly we think that road material bonded with any cement except selenite, and not excepting Portland, which drinks water like a fish, will in high latitudes be short lived.

Hence we prefer bondings of the same with the new cement, or as the merchants say, "make it all wool and a yard wide."

Wood pavements, like cobble-stone pavements, are apparently as essential in pioneer life as the dugout of the prairie, or the balloon frame of a mushroom city, and therefore to be tolerated only. It can not be otherwise considered, for while these wood pavements are noiseless they are the home of poisonous exhalations, and are short lived. So poisonous are these exhalations that, were it not for the powerful action of the chemical world, which so faithfully neutralizes the dangerous conditions of the air we breathe, the most prohibitory laws possible would be on the municipal codes of our cities against their use.

EXPERIMENTS ON PAVING BRICK.

By J. F. Fisher.

IT is clearly demonstrated that only the best quality of brick is suitable for paving purposes, but there is no accepted standard by which to test the quality of the brick before laying it in the street. Brick vary very greatly in quality, and therefore it is very desirable to find a series of tests which will determine the qualities necessary for good paving brick. It was with the hope of determining such a standard that the following experiments were made.

Invitations were sent to the principal makers in all places where it was known that especial attention was given to the manufacture of paving brick, asking them to contribute samples. Not all responded, but samples were received from the following places, viz.: Bardolph, Ill.; Bloomington, Ill.; Charleston, W. Va.; Columbus, Ohio; Decatur, Ill.; Galesburg, Ill.; Sergeant Bluff, Iowa, and Urbana, Ill. This order of arrangement is not that given in the tables, the latter being purely accidental.

Each individual brick was tested to determine (1) its transverse strength, (2) absorbing power, (3) specific gravity, (4) crushing strength, and (5) resistance to abrasion.

TRANSVERSE STRENGTH.

These experiments were made on Riehle Bros. testing machine in the testing laboratory of the University of Illinois. The brick were supported on knive edges six inches apart, and the load was applied by another knife edge brought to bear midway between, and parallel to, the other two.

The modulus of rupture was computed by the formula:

$$W=\frac{2\,b\,d^2}{3\,l}\,R$$

In which W represents the load; b, d, and l the breadth, depth, length, in inches, respectively; and R the modulus of rupture, in pounds per square inch.

The value of R for the different kinds of brick is found in Table I.

TABLE I.—TRANSVERSE STRENGTH.

DESIGNATION OF BRICK.	Number Tested	MODULUS OF RUPTURE.		
		Min.	Max.	Mean.
A	6	743	1,950	1,013
B^1	3	1,310	1,750	1,496
B^2	4	880*	1,650	1,243
B^3	3	1,400	2,260	1,686
C	2	1,620	1,740	1,680
D	7	680†	2,160	1,247
E	6	900	1,850	1,333
F	8	1,150	2,620	1,790
G	7	630‡	1,675	1,187
H^1	2	1,510¿	2,730	2,120
H^2		??	??	??

*Clay not well cemented.
†Clay not homogeneous and poorly cemented.
‡Very poorly burned.
¿Excessive lamination.

ABSORBING POWER.

To determine the absorbing power bricks were used which had lain in a steam-heated room from one and one-half to six months. After breaking them transversely, as described above, one-half of each brick was selected, weighed and immersed in water from twenty-eight to forty-eight hours, and then wiped with blotting pads till there was no water on the surface, when it was again weighed.

The water absorbed in terms of the weight of the brick is given in Table II.

TABLE II.—ABSORBING POWER.

DESIGNATION OF BRICK.	Number Tested	WATER ABSORBED IN PER CT. OF THE WT. OF THE BRICK.		
		Min.	Max.	Mean.
A	6	6.8	11.0	8.5
B^1	3	0.7	1.9	1.3
B^2	4	5.8	6.3	5.9
B^3	3	1.2	7.3*	4.8
C	2	1.0	1.3	1.2
D	7	4.7	10.2	7.1
E	6	1.6	6.4†	2.6
F	8	1.1	10.7‡	6.1
G	7	7.1	22.3¿	12.5
H^1	2	1.2	5.8	3.5
H^2	2	1.9	3.1	2.5

*Brick contained small particles of lime.
†This is the only one of six samples that exceeded 2.2 per cent.
‡The excessive variation between Min. and Max. is due to one being very hard and the other only medium hard burned. The fact that part were burned in an up-draft and part in a down-draft kiln was not known to the writer until the experiments had been made.
¿Very poorly burned.

SPECIFIC GRAVITY.

The specific gravity was determined by using the same half bricks that were used in determining the absorbing power. The weight before and after immersion being already determined in order to obtain the absorptive power, then to obtain the specific gravity it was only necessary to determine the weight of the brick in water.

The specific gravity was then computed by the formula:

$$\text{Specific Gravity}=\frac{W}{W'-W''}$$

in which W= weight before immersion, W'= weight after immersion, and W''= weight immersed in water.

The results obtained for the different brick are given in Table III below.

TABLE III.—SPECIFIC GRAVITY.

DESIGNATION OF BRICK.	Number Tested	SPECIFIC GRAVITY.		
		Min.	Max.	Mean.
A	6	1.82	1.95	1.90
B^1	3	2.18	2.22	2.21
B^2	4	2.07	2.09	2.08
B^3	3	2.05	2.19	2.11
C	2	2.14	2.27	2.21
D	7	1.91	2.04	1.98
E	6	2.05	2.19	2.12
F	8	1.98	2.33	2.15
G	7	1.53	1.85	1.74
H^1	2	2.17	2.30	2.24
H^2	2	2.22	2.30	2.26

CRUSHING STRENGTH.

This was determined by taking the remaining half of each brick that was tested for transverse strength, and breaking off one side and end until it was approximately a cube. The cubes were then prepared for crushing by one of the three following methods:

1. Two opposite faces were covered with a thin coating of plaster of Paris, which was allowed to harden and was then ground to a plane surface on a sand paper disk, leaving only enough plaster adhering to the brick to fill up the depressions.

2. If the brick have glazed surfaces it is impossible to make the plaster stick tight enough to prevent its being broken off by the revolving disk; and other means of securing a flat surface had to be resorted to. With this class of brick, two opposite faces were covered with a thin coating of plaster; then the brick was put into the machine and about one thousand pounds per square inch of pressure brought to bear upon it before the plaster had time to set. It was then allowed to remain under pressure till the plaster became hard—usually about twenty-four hours.

3. A little experience showed that the last method was too slow to permit of finishing the experiment in the time available, and hence the faces were carefully ground to a plane surface on an emery wheel, which was a much more speedy method.

The first method is the most rapid and gave satisfactory results. The second gave satisfactory results if only a thin coating of plaster is used—only enough to fill up the depressions,—but the time required for the plaster to harden makes it undesirable. The third method requires more work than either of the other two; and it is impossible to get as good a surface on an emery wheel as on a sandpaper disk.

After the brick were prepared they were crushed between self-adjusting cast iron plates, with results as given in Table IV.

TABLE IV.—CRUSHING STRENGTH.

Designation of Brick.	Number tested.	CRUSHING STRENGTH OF CUBES, LBS. PER SQ. INCH.		
		Min.	Max.	Mean.
A	6	3,920	9,540	6,860
B^1	2	6,990	14,100	10,545
B^2	2	9,600	10,250	9,925
B^3	3	6,910	11,275	9,820
C	2	4,600	5,920	5,260
D	5	3,775*	9,400	5,691
E	6	4,585	8,060	5,468
F	7	5,790	12,100	9,494
G	4	4,700	5,670	5,185
H^1	2	4,770†	11,690	8,230
H^2	1	5,890	5,890	5,890

*Height greater than diameter.
†Badly laminated.

RESISTANCE TO ABRASION.

The abrasion tests were made by means of a foundry rattler, used for cleaning castings. In this particular case this was a cylinder three feet nine inches long by twenty-six inches in diameter, and revolved at the rate of twenty-four revolutions per minute. In order to have the conditions in the rattler similar to that in the

street, five hundred and forty-six pieces of smoothly worn "foundry shot," averaging about one-sixth pound per piece and having a total weight of eighty-three and one-half pounds, were put into the cylinder with the brick. This was thought to come the nearest to producing the same effect as the shoes of the horses and the wheels of the vehicles of anything that could be had.

The brick that were used were the ones that had previously been tested for absorption, all sharp corners produced when the brick were broken transversely being first broken off. Each piece was weighed, and twelve of them put into the rattler, which was then revolved for thirty minutes, when the brick were weighed again. This operation was repeated three times for each brick. The results are given in Table V.

TABLE V.—PER CENT. OF LOSS BY ABRASION.

Designation of Br'k.	Number tested.	First Half Hour.			Second Half Hour.			Third Half Hour.			For One and One-Half Hours.		
		Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.
A	3	4.4	5.6	4.9	2.3	3.7	3.0	2.1	3.1	2.6	8.8	12.4	10.5
B^1	3	1.4	3.2	2.1	0.6	1.8	1.3	0.4	1.1	0.7	2.4	6.1	4.1
B^2	2	2.4	4.8	3.6	1.8	3.2	2.5	1.5	2.4	2.0	5.7	10.4	8.1
B^3	2	1.8	8.2	5.0	1.5	4.8	3.2	0.8	4.2	2.5	4.1	17.2	10.7
C	2	1.2	2.2	1.7	0.7	1.1	0.9	0.7	1.0	0.9	2.6	4.3	3.5
D	5	4.3	8.0	6.3	2.2	6.3	3.5	1.5	5.9	3.0	8.0	20.2	12.8
E	6	2.0	4.8	3.1	1.0	2.5	1.5	0.7	1.9	1.3	3.7	9.2	5.9
F	6	2.1	8.4	4.5	0.8	3.7	3.1	0.6	3.0	1.9	3.5	15.1	9.5
G	2	4.8	6.5	5.7	2.9	5.3	4.1	2.8	4.6	3.7	10.5	16.4	13.5
H^1	2	2.8	5.6	4.2	1.1	2.9	2.0	0.6	1.8	1.2	4.5	10.3	7.4
H^2	2	2.8	3.7	3 3	1.5	1.7	1.6	0.9	1.5	1.2	5.2	6.9	6.1

B^3 had been in use in pavement for 4 years in a main street of a city of 15,000 inhabitants.
G was taken from the pavement in the middle of the main street of a city of 8,000 inhabitants, *where it had been in use for five and one half years.*
H^2 was taken from near the center of the street between two large wholesale houses, and had been in service for 17 years.

The per cents. given in Table V were all computed upon the original weight of the piece tested, so that adding the per cents. of loss for the three separate half hours gives the total loss for the one and one-half hours.

The results obtained by the several tests are collected in Table VI, which is useful in making comparisons.

TABLE VI.—SUMMARY OF PRECEDING TABLES.

DESIGNATION OF BRICK.	Transverse Strength.	Absorbing Power.	Specific Gravity.	Crushing Strength.	Loss by Abrasion.
A	1,013	8.5	1.90	6,860	10.5
B^1	1,496	1.3	2.21	10,545	4.1
B^2	1,243	5.9	2.08	9,925	8.1
B^3	1,686	4.8	2.11	9,820	10.7
C	1,680	1.2	2.21	5,260	3.5
D	1,247	7.1	1.98	5,691	12.8
E	1,333	2.6	2.12	5,468	5.9
F	1,790	6.1	2.15	9,494	9.5
G	1,187	12.5	1.74	5,185	13.5
H^1	2,120	3.5	2.24	8,230	7.4
H^2	? ? ?	2.5	2.26	5,890	6.1

It is now quite generally admitted that the power to resist blows (not crushing strength) is the most desirable quality for paving brick. Brick crushed in a pavement is something uncommon, if the brick is anywhere near the average of those used in these experiments; and pavements that have been down any length of time will show the effect of blows received from the shoes of horses and the wheels of vehicles.

If, then, we adopt the resistance to blows as the best method for determining the qualities desirable in a paving brick, the value of the other tests will depend on their agreement with the tests for abrasion. Such comparison may easily be made from Table VI. If we form a table similar to Table VI, except that instead of giving the results we give the rank which the several bricks have in the different columns of that table, we get the first part of Table VII (page 52). If we take the difference between the rank for abrasion, and the rank for each of the other four methods of testing, we obtain the last part of Table VII. Now the column of these differences which gives the smallest sum when added must necessarily show which is the second best test, since the results obtained by that test most nearly coincide with those obtained by our "best method," *i. e.*, by abrasion.

From Table VII we see that by adopting resistance to abrasion as our best method for determining the qualities desirable in paving brick, the others rank in the following order: absorbing power, specific gravity, transverse strength, and crushing strength, or in the inverse order with the difficulties of making the experiments, especially so for the last four methods. Although we are by the above means able to show the comparative value of the different methods of testing, yet Table VII shows that the results obtained by the different methods do not agree closely enough to warrant the statement that any one test is sufficient to determine the qualities necessary for a paving brick. Not less than two methods should be used, in which case tests of resistance to abrasion and of absorbing power are to be preferred; and if it is impossible to make the former, the transverse strength is to be preferred next.

TABLE VII.—COMPARISON OF METHODS OF TESTING.

DESIGNATION OF BRICK.	RELATIVE RANKS IN TABLE VI.					DIFFERENCE BETWEEN THE RANK FOR ABRASION AND THE RANK FOR			
	Transverse Strength.	Absorbing Power.	Specific Gravity.	Crushing Strength.	Abrasion.	Transverse Strength.	Absorbing Power.	Specific Gravity.	Crushing Strength.
A	10	10	9	6	8	2	2	1	2
B^1	5	2	3	1	2	3	0	1	1
B^2	8	7	7	2	6	2	1	1	4
B^3	3	6	6	3	9	6	3	3	6
C	4	1	3	10	1	3	0	2	9
D	7	9	8	8	10	3	1	2	2
E	6	4	5	9	3	3	1	2	6
F	2	8	4	4	7	5	1	3	3
G	9	11	10	11	11	2	0	1	0
H^1	1	5	2	5	5	4	0	3	0
H^2	?	3	1	7	4	?	1	3	3
						33†	10	22	36

The specific gravity tests agree so closely with those for absorbing power that the former are unnecessary.

From the results given in Table VI we may draw the conclusion that a brick that has a transverse strength of 1,200 pounds per square inch, does not absorb over 8 per cent. of its weight of water, has a specific gravity of 2, has a crushing strength of 5,000 pounds per square inch, and will not lose by abrasion more than 8 per cent. of its weight in one and one half hours under conditions as above, will give excellent service in a pavement.

SCHEDULES OF WATER RATES.

By J. Nelson Tubbs.

IT is a well understood fact that schedules of water rates for cities and towns in which water has just been introduced are usually established on the basis of charges in other cities and towns of like population, where the works have been in operation for a considerable period, and not as a result of a detailed study of the elements of cost of construction and maintenance, and probable revenue. A little reflection will satisfy any one that the usual plan

is unphilosophical, and is simply guess-work. Whether the works are constructed and owned by a municipality or by a private company, the general rule remains the same, that in some way the works must be made to pay, otherwise the original and consequent continued investment would not be made. It is further true that the conditions as to source of supply, length of conduit, quality of soil and required size and length of distribution pipes, are not alike in any two towns, and therefore the cost of construction and maintenance must necessarily be unlike; and as a consequence the schedules of water rates must differ for each town, provided they are fair and equitable alike to the owner and consumer. Assuming the correctness of the foregoing premises, the conclusion must follow, that some more rational method than the *rule of thumb* should be adopted to be determine an approximately correct and equitable schedule of water rates for each case. I, therefore, respectfully submit to this association, for the consideration and criticism of its members, the following method for such determination:

(1) Determine the sum represented by the original cost of the works compounded at 4 per cent. per annum for twenty years. (2) Determine the sum represented by the estimated yearly cost of operating expenses and repairs, each said yearly sum compounded at 4 per cent. for its proper number of years, from twenty to one. (3) Determine the sum represented by the estimated yearly cost of extensions of pipe distribution, each said yearly sum compounded at 4 per cent. for its proper number of years, from twenty to one. (4) Determine the sum of money which at the end of twenty years will represent the cost of metering each service as it is put in, including interest, repairs and depreciation, the life of a meter being taken at twelve years. The sum of the four preceding items will represent approximately the total cost of the works at the end of twenty years, including compound interest at 4 per cent. on each item of expenditure from the time it accrued to the end of the twenty year period. (5) From the sum thus obtained deduct the estimated yearly hydrant rentals to be received for twenty years, each year's rental being compounded at 4 per cent. for the number of years from date of receipt to end of twenty years, the determination of yearly hydrant rental to be made in accordance with the method suggested in a paper read by me before the American Water Works Association, at its meeting in Cleveland two years ago. The resultant difference will represent the amount of expenditure made, together with accumulated interest, for a period of twenty years, which said amount must be paid out of the receipts for water sold. The amount of water sold in the twenty years is approximately determined by the following described method:

In these days it is not difficult for the hydraulic engineer who designs and conducts a system of water-works to determine, with substantial accuracy, its capacity in gallons per day, either by the application and solution of a proper hydraulic formula, or by actual measurement. From the capacity thus determined, my experience would lead me to deduct 20 per cent. of the whole supply as a reasonable estimate for loss by evaporation from reservoirs, from undiscovered underground leaks, from the use of water for the suppression of fires, from the willful or malicious waste of water from unmetered fixtures, and from the imperfection of meters or other registers, used in measuring the water supplied to consumers. There will thus remain only 80 per cent. of the total supply from which a return in water rents is made to the owner. As it is usual to plan works with the design that they shall furnish a sufficient supply of water for a growing town for a period of at least twenty years, and we may assume that at the end of that period the water will be all used and paid for in rates. For the purpose of an approximate calculation we may also assume that one-twentieth of the whole amount will be sold the first year, two-twentieths the second, and so on in like proportion for the remaining years. On this assumption it is not difficult to determine the total number of gallons of water which will have been sold at the end of twenty years. (6) If the total expenditures at the end of twenty years, less the total hydrant rental, be divided by the total amount of water sold, we shall have as a result the *rate* at which the water must be sold to balance the account at the end of twenty years. Apparently, by this process, the owner of the works will at the end of twenty years have received back all money previously expended by him in the construction and operation of the works, together with 4 per cent. compound interest thereon. There is, however, one fallacy in the process, and it consists in the fact that no allowance of interest is made on the receipts for water sold year by year during the twenty years. The amount of this interest may, however, now be determined, as the amount sold each year and the price charged for the same are known, the compound interest on each of said yearly amounts for their respective periods up to twenty years is easily determined; and when determined, it will be treated as a percentage of profit to the owner, to be added to the 4 per cent. previously allowed for the use of his money.

While it is claimed for this method that it will determine with approximate accuracy the price to be charged per 1,000 gallons in any given case, where the water is measured by meter, yet as in some cases it may not be practicable or convenient to apply a meter, it therefore becomes necessary to prepare a schedule of fixed rates for special uses of water. As such a schedule must be based upon the rates charged per 1,000 gallons, it is not especially difficult for the experienced water-works manager to convert such special use into gallons per day, which, multiplied by the rate per gallon, or 1,000 gallons, will determine the fixed rate to be charged for the special use.

That the foregoing method may be more clearly understood, I proceed to illustrate by a purely imaginary case, as follows: Suppose a system of water-works is just completed in a growing town under the following conditions: The present population is 4,000; the rate of increase is estimated at 250 per year; the capacity of the works is one and one-half million gallons per day; the original cost is $100,000; the estimated yearly cost of repairs and operating is $8,000; the yearly cost of pipe extensions is estimated at $4,000; the number of hydrants at first set is 70, and they are estimated to increase at the rate of 10 each year for twenty years; that 100 services and 100 meters for same are put in each year for twenty years, when it is expected the capacity of the works will be reached, and the yearly rental of each hydrant will be, as determined by my method, $35. Under these conditions, what should be the rate charged per 1,000 gallons for use of water?

SOLUTION.

$100,000 at compound interest for twenty years at 4 per cent.	$219,000 00	
$8,000 yearly repairs and operating expenses, each said yearly sum compounded at 4 per cent. from the date it accrued until expiration of twenty years	247,760 00	
$4,000 yearly expenditure for pipe extensions, compounded as in last preceding item	123,880 00	
$3—Being the sum necessary to be placed yearly at compound interest at 4 per cent. for each meter, and which will pay yearly interest, $0.95, yearly depreciation, $1.30, and yearly repairs, $0.75, and renew the meter each twelve years; the process being carried on for twenty years, until all services are metered	85,403 00	
Total		$676,043 00

DEDUCT FROM SAID SUM.

$35, the determined yearly rental value of each hydrant, at compound interest at 4 per cent. from the date when it accrued to the end of twenty years	158,429 00
Balance to be made up from water rents	$517,614 00

It now becomes necessary to determine the total amount of water sold during the twenty years. We have assumed that the total amount of supply is 1½ million gallons per day, and that 80 per cent or 1,200,000 gallons per day, or 438,000,000 gallons per year, is available for revenue. We have also assumed that 1-20th

of this amount, or 21,900,000 gallons, is sold the first year, 2-20ths the second year, and so on to the end of twenty years. A summation of these yearly sales in the case in hand shows the total amount sold to be 4,599,000,000 gallons. If we now divide the $517,614 which is to be paid by the sale of water by the 4,599,000,000 gallons sold at the end of the period, we find that the price per 1,000 gallons must be 11¼ cents. As heretofore stated, the only fallacy in this method is the fact that no interest has been allowed on these sales from the date of sale to the end of the period of twenty years. Applying the price of 11¼ cents to the quantities of water sold yearly, and determining the compound interest at 4 per cent. on these several amounts for their proper periods, we find that it would add 1⅛ per cent. yearly to the income of the works up to the end of the twenty years, or give the owner a yearly return from his investment for the first twenty years of 5⅛ per cent. It will be readily seen that at the end of twenty years all the money previously expended on the system, with 5⅛ per cent. interest added, will have been paid, and that from thence onward the percentage of receipts over expenditures will be very large; or, in other words, that the works will pay a very large percentage on the yearly investment and will be very profitable, and the rates may, soon after the end of the twenty-year period, be materially reduced. In mitigation of this reduction of the rates may be named the necessity of renewing the pumping engines and boilers in case of a pumping plant, and more or less expensive changes in the pipe distribution, and the renewal of parts of the same and of the fire hydrants.

I have fixed the period for the summation and balancing of expenditures at twenty years, for the following reasons: (1) That under the interpretation of the laws of the State of New York, at least, all municipalities borrowing money for the construction of water-works are required to provide a sinking fund, which, with accumulated interest, shall at the end of twenty years pay the amount thus borrowed. (2) That works are usually designed for furnishing a supply sufficient for a growing town for a period of twenty years. (3) That it is questionable whether, in the average of cases, it is prudent or profitable to make such an expenditure as would provide a supply for a period exceeding twenty years. (4) It is questionable whether capitalists with a full knowledge of the facts would be willing to wait longer than a period of twenty years for a determination of the question whether the investment made is to be a financial success. (5) In cases where the construction of works involves the use of pumping engines, boilers and stand-pipes, large expenditures are liable to be necessary on the renewal of the same within or at the end of twenty years. (6) The exact financial standing of a company with a large investment of capital should be capable of determination at the end of a period of twenty years, to enable its securities to have a merchantable value. The uniform use of four per cent. interest in the foregoing method is based on the fact that it is the percentage paid to depositors by savings bank institutions.

The necessary expenditure for applying a meter to each service is based upon the following reasoning:

The only fair and equitable way in which to sell water is by measure, as in the case of other merchantable commodities, and the corporation offering it for sale should furnish such measure, and when thus furnished it becomes a part of its stock in trade as much as any other part of its plant, the expenditure for which should be reimbursed by the consumer, in the rates paid by the consumer for the uses of water and for the same reason that the merchant charges such a percentage of profit in the sale of his goods as will reimburse him for the rental of his store, and for the supply of scales or other measures for the goods sold. I therefore assume, for the purposes of this discussion, that every water service should be metered, that the meter should be regarded as an integral part of the water-works plant, and that the user of water should contribute in yearly rates such sum as will remunerate the owner of the works for procuring and maintaining said meters.

While absolute correctness is not claimed for the foregoing method, yet it is claimed by the writer, that it furnishes, a simple, logical and approximately correct method by which a company or a municipality may determine upon a rational and equitable schedule of water rates from the beginning, so that on one hand the work shall pay as an investment, and on the other hand that the consumer shall not be overcharged and oppressed by excessive charges for water. The method is submitted as simple enough for popular use, and accurate enough to determine a successful business venture. The method is equally applicable for use in the case of municipalities, as well as in that of private corporations, except in the case of the latter; another element will have to be introduced in the determination of total expenditure at the end of twenty years, and that is the item of yearly taxation, which is to be treated in precisely similar manner as the yearly cost of repairs and operation, and which will of course increase the amount of total expenditure, and also the rate to be charged per one thousand gallons for use of water.

HINTS TO COUNTRY ROADMEN.

THE Roads Improvement Association of London, England, the purpose of which is to educate local highway authorities and contractors in the best methods of road improvement and maintenance, makes the following recommendations:

"Never allow a hollow, a rut or a puddle to remain on a road, but fill it up at once with *chips* from the stone heap. Always use *chips* for patching, and for all repairs during the summer months. Never put fresh stones on the road if by cross-picking and a thorough use of the rake the surface can be made smooth and kept at the proper strength of section. The rake is the most useful tool in your collection, and it should be kept close at hand the whole year round. Never spread large patches of stone over the whole width of the road, but coat the middle or horse-track first, and, when this has worn in, coat each of the sides in turn. In moderately dry weather, and on hard roads, always pick up the old surface into ridges six inches apart, and remove all large and projecting stones before applying a new coating. Never spread stones more than one stone deep, but add a second layer when the first has worn in, if one coating be not enough. Use a steel-pronged fork to load the barrows at the stone heap, so that the siftings may be available for 'binding' and for summer repairs. Never shoot stones on to the road and crack them where they lie, or a smooth surface will be out of the question. Go over the whole of the new coating every day or two with the rake, and never leave the stones in ridges. Never put a stone upon a road for repairing purposes that will not pass freely in every direction through a two-inch ring, and remember that still smaller stones should be used for patching and for all slight repairs. Hard stone should be broken to a finer gauge than soft, but the two-inch gauge is the largest that should be employed under any circumstances. Never be without your ring-gauge. It should be to the roadman what the compass is to the mariner; and if you have no ring-gauge, remember MacAdam's advice that any stone you can not easily put in your mouth should be broken smaller. Use nothing but *chips* for binding newly laid stones together, and remember that road sweepings, horse droppings, sods of grass, and other rubbish, when used for this purpose, will ruin the best made roads.

"Water-worn or rounded stones should never be used upon steep grades, or they will fail to bind together.

"Never allow dust or mud to lie on the surface of the road, for either of these will double the cost of maintenance. Dust becomes mud at the first shower, and mud forms a wet blanket which will keep a road in a filthy condition for weeks at a time, instead of allowing it to dry in a few hours. See that all sweepings and scrapings are put into heaps and carried away immediately.

"The middle of the road should always be a little higher than the sides, so that the rain may run into the side gutters at once. Never allow the water-tables, gutters and ditches to clog up, but keep them clear the whole year through. Always be upon your road in wet weather, and at once fill up with "chips" any hollows or ruts where the rain may lie. When the main coatings of stone have worn in, go over the whole road, and, gathering together all

the loose stones, return them to the stone heap for use in the winter to follow; for loose stones are a source of danger and annoyance, and should never be allowed to lie on any road.

"Never allow the grating bars of any gutter or drain to remain parallel with the road, but always set them crosswise and so avoid serious accidents. No grating, man-trap, water plug, gas pipe or drain should ever be allowed to project above the surface of the road under any circumstances.

"Remember that any negligence on your part may cause the rate-payers to lose the benefit of the government grant—given toward all main roads kept in an efficient state of repair—as well as render your surveyor or overseer liable to an action at law."

PERSONAL.

Henry A. Mansfield has been elected city engineer of Indianapolis.

Mr. Wm. P. Rounds has been appointed superintendent of water-works at La Salle, Ill.

Henry C. Allen has been appointed city engineer of Syracuse, N. Y. He has been deputy city engineer for some time.

D. G. Barnard, superintendent of the Haddonfield, N. J., waterworks, died recently from injuries received by being thrown from a wagon.

Mr. William Helm has been appointed city engineer of Newport, Ky., taking the place of the late C. L. Jungerman. Mr. Helm has been assistant in the Newport engineering corps for some time.

Mr. Ernest Adams has retired from the position of city engineer of Newark, N. J., after twenty-five years of service, twenty years as principal assistant and five years as chief of the department.

Mr. Ludden has returned to his old position as city engineer of Detroit. His first work will be to give special attention to the paving of the city. He says that there is imperative need of a radical change in the present methods.

Messrs. J. Herbert Shedd, city engineer of Providence, R. I.; J. P. Davis, of New York, and E. W. Bowditch, of Boston, have been appointed a commission to report on the proper methods of conducting the engineering department of Boston, Mass.

Colonel McBean has laid in Chicago nearly 1,500,000 yards of cedar blocks within the past four years Besides this he has paved much of Kansas City's streets, those of Springfield, Indianapolis and others, and has now on hand enough contracts to complete a total of 400,000 square yards in Chicago for the year 1890.

THE PAVING BRICK INDUSTRY IN IOWA.

BRICK is to be the coming industry in Des Moines and vicinity. The great abundance of material of all qualities in inexhaustible quantities is to be found in our corporate limits, and, in fact, everywhere in Polk county. This, of course, has been well known for years, but as there has been only of late a demand for paving brick, there has been no systematic attempt to test the good qualities of the material. Since our city has thrown off the "cedar block yoke," so to speak, and the public voice in favor of paving our streets with material found in our own city, which could be produced by home labor, has become more pronounced, some of our brick-makers have turned their attention to the making of paving or vitrified brick, and well have they succeeded in getting to the front with paving brick, which to all appearances is as good, if not better, than any yet made in this part of the country. They are pronounced equal to the Galesburg article, over which the citizens of that city boasted so much. By the kindness of S. A. Robertson, Martin Flynn and others, of the Des Moines Brick Company, and the courtesy of L. M. Martin, of the Des Moines and Northern Railway, a large company of business men, lawyers, bankers, contractors and others visited this new plant early this week and were shown the art of modern brick making. The plant is a very extensive one, but it will have to be increased, especially in the kiln capacity, as the brick machines have a capacity of about 75,000 per day. The clay is of as fine a quality as can be found anywhere and is as inexhaustible. Mr. W. A. Eudaly, of Cincinnati, superintended the construction of the works, and as he is an experienced brickmaker, everything has been done possible to give the company a perfect plant. The paving brick now being turned out by this company has already attracted the attention of Omaha, and a contract has already been made with that city for 280,000 for paving purposes and cars were being loaded at the time of the visit. It takes about ten days to complete the burning of a kiln of these vitrified brick, and a look into the "peep-hole" of one of these kilns while the firing was at its hottest stage, is a sight which would make an old hardened sinner perspire.—*Des Moines Mail and Times.*

NO DOUBT OF OUR SUCCESS.

PAVING AND MUNICIPAL ENGINEERING is a new publication devoted specially to street and sidewalk paving, sewerage, water-works construction, bridge building, street lighting, and all matters pertaining to municipal engineering. The journal is under the management of William C. Bobbs, and published at room 44, Chamber of Commerce, Indianapolis, Ind. We extend congratulations and have no doubt about our contemporary's success, as there is a field and ample scope for such a publication. The unsatisfactory sanitary condition of our cities is a most important matter for observation, exposure, agitation and reform. And a journal that will print wisely and fearlessly, what should be done to secure sanitary reform and good engineering will ever receive the good wishes and encouragement of all honest citizens. We hope that PAVING AND MUNICIPAL ENGINEERING will find a large circulation in Chicago.—*The American Engineer.*

A CRITIQUE ON MR. HOWARD'S "PAVING PROBLEM."

TELFORD and Macadam would have been better than Telford and Stephenson, because the railroad builder was the innocent cause of retarding real road building for hundreds of years. This is the reason why the "city is not as good a home as is the house for its inhabitants." This is the real cause of delays; travel that could go by rail has so gone, to the prejudice of road building. There is really no reason for "examining all and retaining the best." Can not the people who build auditoriums and sky scrapers build streets and roads? Certainly they can, and as certainly they will not, till compelled to. In all seriousness, bad roads are the direct result of cupidity. It is the veriest nonsense to claim that men do not build good streets from ignorance of correct methods. We who are road experts know far more of streets and roads than we do of our finger nails.

W. L. S. BAYLEY, C. E.

BOOK NOTICE.

A Treatise on Masonry Construction: By Ira O. Baker, C. E., Professor of Civil Engineering, University of Illinois. Cloth; 556 pp. New York: John Wiley & Sons.

This work, the scope of which is fully indicated by its title, is especially valuable to builders, and is an excellent text-book for students of engineering. It has the distinctive and rather exceptional merit of being strikingly comprehensive in its treatment of technical questions. The author says that in writing the treatise he endeavored "to develop principles and methods, without confusion of details." He has succeeded in fully attaining his object. As a treatise of construction, embracing nearly all of the various kinds, it is thorough and satisfactory. Its practical value may be better understood from the statement that it comprises matter for which the author has found need in his class-room than from any comment.

PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

WILLIAM FORTUNE, Editor. - - - WILLIAM C. BOBBS, Business Manager.

OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

WE are glad to be able to announce that with this issue the circulation of PAVING AND MUNICIPAL ENGINEERING becomes the largest, so far as can be ascertained, of any monthly in the United States devoted to engineering or contracting interests. The demand for the publication has been even greater than the publishers expected, though sanguine in the beginning of the enterprise that they were entering a richly fruitful field. Requests for it have come in large numbers not only from all parts of the United States but also from Canada. As a further test of the possibilities of the field the publishers contemplate issuing soon a special edition for foreign circulation. The early success which has attended the enterprise has been largely due, it is believed, to a liberal business policy, and this will be continuously pursued in further extending the large circulation which has been already acquired.

ARRANGEMENTS have been made with Mr. James W. Howard, C. E., of Governor's Island, N. Y., to regularly contribute to PAVING AND MUNICIPAL ENGINEERING. It is well known to those best informed regarding such matters, that there is no better authority in the country on paving and kindred subjects than Mr. Howard, who, in addition to possessing thorough engineering knowledge and experience, is an able and scholarly writer. Some valuable articles from him have already appeared in PAVING AND MUNICIPAL ENGINEERING, and the announcement that he is now to become a regular contributor will, we are confident, be pleasing news to our readers. It may be added that arrangements are also in progress for securing the assistance of other technical writers of high standing in making our publication editorially all that can be desired. Articles on each branch of the interests which we represent will be contributed by writers who are exceptionally qualified for the discussion of the subjects which they will treat.

COL. A. A. POPE, of Boston, who has done much to stimulate the rapidly growing sentiment in the United States in favor of better roads, recently delivered an address before a convention of carriage builders in Chicago, on the improvement of country highways, in which he said, referring to the recognition by the association of the important bearing of good roads upon the general public welfare, that the farmers were blind to their own interests and could not be expected to do much toward securing improved highways. He, therefore, advised the carriage makers to take matters into their own hands and, for the benefit of their own business interests, start a movement for road improvement. His argument in support of this advice was that where the roads are best there the most people and the most money are found and there are the greatest number of wheels that represent the best profits to carriage, wagon and bicycle manufacturers. He urgently recommended that these manufacturers make subscriptions aggregating $20,000, the money to be called for as needed, for the establishment of a highway department, in charge of a competent man, for the purpose of starting public opinion in favor of good roads. There was no action on the suggestion, doubtless for the reason that those to whom it was addressed could not see direct or immediate benefits to themselves in such an expenditure of their money, and there is no class of men, who, from intermixed motives of public spirit and business interest, could more reasonably be expected to start such a movement with substantial support.

"THE FINEST ON EARTH."

THE Cincinnati, Hamilton and Dayton Railroad is the only line running Pullman's Perfected Safety Vestibuled Trains, with Chair, Parlor, Sleeping and Dining Car service between Cincinnati, Indianapolis and Chicago, and is the only line running through Reclining Chair Cars between Cincinnati, Keokuk and Springfield, Ill., and Combination Chair and Sleeping Car Cincinnati to Peoria, Ill. And the only direct line between Cincinnati, Dayton, Lima, Toledo, Detroit, the Lake Regions and Canada.

The road is one of the oldest in the state of Ohio and the only line entering Cincinnati over twenty-five miles of double track, and from its past record can more than assure its patrons speed, comfort and safety.

Tickets on sale everywhere, and see that they read C. H. & D., either in or out of Cincinnati, Indianapolis or Toledo. E. O. McCormick, General Passenger and Ticket Agent.—*Adv.*

Improvement and Contracting News.

PAVING.

Sixth street, Des Moines, Ia., will be paved.

Vine street, San Jose, Cal , will be improved.

Fort street, Lafayette, Ind., will be improved.

Water street, Evansville, Ind., will be improved.

A park will be constructed in West Oakland, Cal.

Boydon street, Atlanta, Ga., will be paved with brick.

River street, Aurora, Ill., will be paved with cedar block.

Several streets of Erie, Pa., will be paved with asphalt.

Atlantic avenue, in Atlantic City, N. J., will be paved.

University street, in New Orleans, La., will be paved.

Berry street, Ft. Wayne, Ind., will be paved with asphalt.

Better street pavement is being agitated in Lebanon, O.

Manchester, Va., has appropriated $3,000 to paving sidewalks.

Sundry streets of Harrisburg, Pa., will be paved with asphalt.

Maple avenue in Chicago will probably be paved with asphalt.

Maine street, St. Joseph, Mo., will be paved with pressed brick.

Lenox street, Boston, Mass., will be paved with granite block.

North Church street, Rockford, Ill., will probably soon be paved.

Concrete walks will be laid in several streets of Saccarappa, Me.

Fourteenth avenue, Denver, Col., will be graded and boulevarded.

Montgomery avenue, Pittsburgh, Pa , will be paved with vitrified brick.

Jackson, Mich., is about to pave its main thoroughfares with fire brick.

A number of streets in Jackson, Mich, are to be paved with fire brick.

Five streets of New Utrecht, N. Y., will be graded and improved at once.

North Fourth street, Stillwater, Minn., will be graded at a cost of $7,777.

Colerain Pike at Cincinnati will be improved with vitrified brick or granite.

A large amount of artificial sidewalks will be constructed in San Jose, Cal.

Water and other streets of Newburg, N. Y., will be paved with Belgian block.

Sundry streets of Wilmington, Del., will be paved with Belgian blocks at once.

Rumyour & Gleason have the contract for paving Second street, Duluth, Minn.

A large amount of sandstone sidewalk will be constructed in Independence, Mo.

Grand avenue, in St. Louis, Mo., will be reconstructed at a cost of about $14,000.

The unpaved portion of Collingwood avenue, in Toledo, O., will be paved at once.

The approach to Belle Isle Bridge, at Detroit, Mich., will be paved with asphalt.

Petitions are before council asking that Court street, Utica, N. Y., be paved with asphalt.

The council has passed ordinances for paving and grading sundry streets of Trenton, N. J.

The council, of Dubuque, Ia., will put down a block of brick pavement on Iowa street.

Spoor and Silver avenues, Kansas City, Mo., will be paved and curbed and macadamized.

The contract for the grading of Fairview avenue, St. Paul, Minn., has been let to Thos. Keogh and G. Donnolly, at $8,925.

The Oakland Paving Company has contract for paving Durant avenue, at Berkeley, Cal.

Contractor Kaylor has the contract for the paving of South Calhoun street, Fort Wayne, Ind.

The much talked of paving of Commercial street, Salt Lake City, Utah, will soon commence.

Otto Hoffman has been awarded the contract for paving part of King street at New Albany, Ind.

The question of paving Fifth street, in Martin's Ferry, O., with fire brick, is being agitated.

Lincoln avenue, Bay City, Mich., will probably be paved from Center avenue to Twelfth street.

Lynn street, Columbus, Ohio, will be paved with either wood block, Hayden block or asphalt.

Joseph R. Cavanaugh has been awarded the contract for extensive paving work in Troy, N. Y.

The city engineer may be addressed regarding the construction of plank roads, in Allegheny, Pa.

The mayor of Aurora, Ill., has advertised for about 14,000 square yards of cedar block paving.

The city council at its last meeting ordered asphalt sidewalks on sundry streets of Wilkes Barre, Pa.

A contract for paving forty squares, in Massillon, O., has been let to Geo. W. Lemmon, of Wheeling.

A. Ginglos has been awarded contract for the grading of Cleveland avenue, St. Paul, Minn., at $4,949.

The opening of Seventh street, Kansas City, Mo., a distance of one-quarter of a mile is contemplated.

A. O. Engleman has been awarded contract for Telford pavement on La Fayette street, St. Louis, Mo.

Daniel E. Elliott has been awarded the contract for grading Winslow avenue, St Paul, Minn., at $11,649.

Cherry street, Columbus, O., will probably be paved from Third to Fifth street with Logan fire clay brick.

The California Improvement Company has been awarded the contract for street work at Alameda, Cal.

The board of public works at New Haven, Conn., will ask for $192,000 for street improvement work in 1891.

An ordinance has passed for the paving of Locust street, Omaha, Neb., with Red Colorado paving stone.

The committee on highways have voted to pave several streets of Newburyport, Mass., with granite blocks.

Contract for grading and paving Manborn avenue, Superior, Wis., has been let to Kalver & Burke, at $15,300.

The contract for the reconstruction of La Fayette avenue, St. Louis, Mo., has been let to J. R. Willis at $16,833.

The Engineer's office, Washington, D. C., wishes an appropriation of $500,000 for street improvement work in 1891.

Mayor McDonald, of New Albany, Ind., has been authorized to purchase a street roller weighing 10,000 pounds.

Two hundred and fifty dollars has been appropriated in Groton, Conn., for the purchase of a road machine.

John A. Thorman & Co. have been awarded the contract for paving Fell's Point Market, in Baltimore, Md.

The subject of paving Chicago avenue, in South Evanston is being agitated by the residents on that thoroughfare.

The citizens of Cass avenue, Detroit, Mich., are agitating the subject of asphalt pavement for that thoroughfare.

G. W. Johnson, of Lithonia, has secured the contract for furnishing Louisville, Ky., with 1,000,000 paving blocks.

Geo. I. Miller, of Council Bluffs, Ia , has been awarded a $400,000 paving and grading contract in Key West, Fla.

The chamber of commerce at Chattanooga, Tenn., is interested in a scheme to widen and improve numerous streets.

A petition is being circulated in Kansas City, Mo., asking that Fourth street to the viaduct be paved with macadam.

Walker & Kendrith, of Tampa, have been awarded the contract for paving sundry streets of Key West, Fla., at $150,000.

The question of extending Mill street, Rochester, N. Y., is again being agitated. The work outlined will cost $175,000.

Considerable block and asphalt paving is contemplated in Newark, N. J., and bids for the work will shortly be invited.

The contract for the reconstruction of Cabanne avenue, St. Louis, Mo., has been let to John B. O'Meara at $12,751.

The Rochester Vulcanite Paving Company will probably receive contract for paving Clinton street, in Rochester, N. Y.

The contract for grading and macadamizing Hilgard avenue, Berkeley, Cal., has been let to W. J. Schmidt at $17,000.

Walker & Kendrich, Tampa, Fla., contractors, have been awarded the contract for six miles of sidewalk in Key West, Fla.

The contract for the improvement of Duncan street and Latta avenue, Columbus, O., has been let to the Ohio Paving Company.

The Twenty-sixth Ward Improvement Commission have decided to pave New Jersey avenue, Brooklyn, N. Y., at a cost of $7,000.

J. E. Snyder has been awarded the contract for paving Twentieth avenue, North, Minneapolis, Minn., with cedar blocks.

The board of estimate and apportionment has appropriated $650,000 for repaving and repairing the streets of New York City.

Property owners on Hickory street, Kansas City, Mo., are agitating the question of having that street paved as a business street.

The board of public works at Chattanooga, Tenn., will commence work at once on extensive street paving work contemplated.

Francis J. Morley of Little Falls, N. Y., has been awarded the contract for macadamizing 6,000 feet of road in Bergen County, N. J.

The contract for grading Susquehana, Iowa, Lackawana and Ohio avenues, Duluth, Minn., has been let to Kalver & Burke at $6,527.

The commissioners of Passaic county, in New Jersey, will expend $42,000 in grading and macadamizing sundry roads of that county.

An ordinance has been passed for paving Maple avenue, Evanston, Ill., with asphalt, from Davis street to the South Evanston line.

Ordinance passed council for the improvement and paving of Walnut and First South street, Champaign, Ill., material to be of brick.

The Alameda Macadamizing Company has been awarded the contract for macadamizing East Tenth and Seventh streets in Oakland, Cal.

The board of public works in Superior, Wis., has let the contract for paving and grading Cummings avenue, to Drew & Murtaugh for $18,493.

The Alabama Macadamizing Company have been awarded the contract for macadamizing Twelfth street dyke, in Oakland, Cal., at $3,771.92.

Board of public works at Des Moines, Ia., has been authorized to advertise for bids for paving West Fourth street from Vine to Elm with brick.

The highway committee of common councils in Philadelphia, Pa., has asked for an appropriation of $800,000 for repairing numerous streets in 1891.

The council of Cleveland, O., has been petitioned for the paving of E. Madison avenue from Euclid to Cedar streets, with Medina dressed block stone.

Ordinance is before the Public Improvement Committee of the upper house of the city council, Kansas City, Mo., for the opening and boulevarding of Fairview avenue, a distance of seven miles, to be one hundred feet wide.

Contract to pave Third street from Main to Louisiana, in Little Rock, Ark., with vitrified brick, has been let to Wm. H. Doyle, of Ft. Smith, at $5,000.

Board of County Commissioners, of Kansas City, Mo., have let contract for macadamizing the south approach of the Fifth street bridge to T. J. Foster.

The Oakland Paving Company has been awarded contract for paving Dwight Way, Bancroft Way, and Hopkins Way, Berkeley, Cal., a distance of five miles.

Plans and specifications have been made at Seattle, Wash., for the improvement of Decatur, Moultke and Third streets. Also Joy and Rose streets will be improved.

A resolution has been passed by the city council of Mansfield, O., to pave West Johns street, with fire brick, instead of domestic brick, as originally intended.

The contract for the brick paving of Gordon street, Atlanta, Ga., has been let at about $10,000 to the Chattahooche Brick Company. The distance is about half a mile.

The contract for paving West Federal street, in Youngstown, O., from Holmes street to North avenue, has been awarded to Robert Henderson for about $12,000.

At a recent meeting of the board of public improvements in St. Louis, Mo., the committee on streets presented ordinances for the opening and establishment of five new streets.

The Board of Public Works at St. Paul, Minn., has let a contract for the grading of West Seventh street, from Tuscarora street to the Snelling bridge, to John W. Malone, for $19,640.

The board of aldermen of Brooklyn, N. Y., at its last meeting, considered a resolution for the paving of Seventh street with granite blocks at a cost of $45,000. No action was taken.

Resolutions have been adopted by the common council in Superior, Wis., for the paving and grading of John avenue with cedar blocks, and for curbing with granite or sandstone.

The board of public works of Kansas City, Mo., has recommended to council that Lake street be paved as a business street, from Santa Fe to Hickory, with asphalt, vitrified brick, sandstone or granite.

The Seattle Street Improvement Company, Seattle, Wash., has been incorporated with a capital of $50,000, by Fred E. Sander, Marcus Polasky and Louis D. Brun, to grade and pave public streets, deal in paving material, etc.

A special assessment is to be made in Burlington, Ia., for paving with brick, and curbing Summer street between Spruce and Locust, and for macadamizing, curbing and guttering Maple street between Third and Fourth.

Porter, Raymond & Co. and Baron W. B. Von Richoven, of Denver, Col., have in hand a project for converting Fourteenth avenue into a graded and graveled driveway to connect with and form the western extension of the Mt. Clair and Colorado boulevard.

The Board of Estimates and Apportionments in New York City has been petitioned for an appropriation for the opening of a carriage way to Central Park at Fifth avenue and One Hundred and Tenth street, for the improvement of the plaza at the north end of the park and for the repaving of Fifth avenue.

The Oakland Paving Company entered into contract for the macadamizing of Dwight way from Shattuck to San Pablo, Bancroft way from Snattuck avenue to Choate, and Hopkins street from Josephine street to San Pablo, in Berkeley. This is an immense amount of work, amounting to over five miles of macadamizing. This is the most street work that has ever been let before in Berkeley.—*Oakland Enquirer.*

Aurora, Ill., proposes to proceed as soon as practicable with the paving of business streets. The Mayor has advertised for paving with cedar blocks, Fox street, from the east end of the bridge to the Chicago, Burlington and Quincy railroad track; Main street, from Broadway to the tracks; New York street, from the bridge to the tracks; Broadway, from New York to Fox street, and Downer place, from River street to Lake, the total amount of paving required being 14,000 square yards.

SEWERS.

A sewer will be built on Walnut street, Santa Cruz, Cal.

Albuquerque, N. M., is putting in a $50,000 sewer system.

Considerable sewer work is contemplated in Glens Falls, N.Y.

Attleboro, Mass., has appropriated $3,500 for sewer construction.

Iron Mountain, Mich., will probably borrow $15,000 for sewers.

A sewer will be constructed on Hollis street, in Cambridge, Mass.

The question of building sewers is being agitated in Sherman, Tex.

Considerable sewer work is contemplated in Peekskill, N. Y., at once.

Brunswick, Ga., has let a contract for the construction of a sewer system.

Contracts will be let at once for constructing sewers in Middletown, Pa.

A sewer will be laid on Seventeenth and other streets of Covington, Ky.

Beatrice, Neb., has voted to issue $15,000 bonds for the construction of sewers.

A sewer will be built in Cleveland and Wabash avenues, at St. Paul, Minn.

In Phenix, Arz., the question of a complete system of sewers is being agitated.

J. McDonald has contract for putting in a sewer system at Denison, Texas.

Contracts will be let shortly for sewer construction work in New Britain, Conn.

Hoboken, N. J., has had plans prepared for a sewer system to cost $250,000.

Youngstown, Ohio, will probably borrow $20,000 for the construction of sewer.

The sewer system of Berkeley, Cal., will be entirely overhauled and repaired.

A sewer to cost $132,000, will probably be built in West Denver (Colo.) District No. 1.

W. H. Chilcoat is the lowest bidder for the Westling street sewer, Newark, O., at $3,230

A sewer will be built on Fifth street between Second and Sixth ave., Duluth, Minn.

The question of a complete system of sewers in Birmingham, N. C., is being agitated.

The Council in Erie, Pa., has ordered that a sewer be constructed on Eighteenth street.

Sewers will probably be constructed in Webster and Catherine streets, Saginaw, Mich.

W. R. Davis has contract for the west Main Street sewer to be built at once in Newark, O.

Rose & Riley, of Albuquerque, N. M., have secured the contract for putting in sewers at $40,000.

Maj. Jones, of Spokane Falls, made plans for a $60,000 sewer system in North Yakima, Wash.

The city surveyor has been instructed to prepare plans for sewers in sundry streets of Utica, N. Y.

Thirty seven thousand dollars will be expended in the construction of new sewers in Rochester, N. Y.

Schweeble Brothers have secured the contract for the construction of sundry sewers in Lancaster, Pa.

W. A Schmidt, of Berkeley, has been awarded a $5,000 sewer contract to be constructed in Napa, Col.

The Citizens' Improvement Association is endeavoring to secure a sewerage system for West Berger, N. J.

Work will be actively pushed on the construction of the immense Tasker Street sewer in Philadelphia, Pa.

Ordinance passed council for the construction of a sewer in District No. 2, Salt Lake City, Utah, at $101,000.

Work will be expected to commence at once on the construction of a new sewer system in Orange, N. Y.

A new plan for the disposal of Chicago's sewerage is under contemplation. It contemplates a tunnel twenty feet in diameter, from Chicago to Joliet. The cost of its construction is estimated at $12,194,523.

Fifty thousand dollar bonds will probably be issued for sewers to be constructed in New Whatcom, Wash.

The Sewer Commissioners, of Rockaway, N. Y., are considering the proposition to put sewers in the village.

A complete system of sewers will probably soon be constructed at Ypsilanti, Mich., after plans by H. P. Glover.

Contract has been let to Claud Veits for construction of sewers in Milford District, St. Louis, Mo., for $218,727.

S. West of the West Sewerage Company, New York, has contracted for five miles of sewerage in Brunswick, Ga.

The Wilmington Sewerage Company has been organized for the construction of sewers, at Wilmington, N. C.

Mr. J. B. Slommons has been awarded the contract for putting in a sewer on Williams avenue, Portland, Ore.

The sewerage committee has recommended that sewers be constructed on South Walnut street, Orange, N. J.

The city council of Spokane Falls, Wash., is about to make surveys and draw plans for a $60,000 sewerage system.

J. & P. O'Donahue have been awarded contract for sewer at Cleveland, O., in Lamont street, from Holt to Republic.

Flanagan & O'Hara have been awarded the contract for constructing a sewer in Capouse avenue, Scranton, Pa.

J. S. Belser, has been awarded the contract for the construction of the street sewer in San Francisco, Cal., at $50,000.

Petitions are before the trustees of College Point, N. Y., providing for the extension of various sewers and water-works.

The contract for the construction of sewers in District No. 1, Dayton, O,, has been let to Bruno Bitty, the lowest bidder.

John C. Robertson, Wm. I. Dashiell and F. Z. Caracristi have offered to furnish Manchester, Va., with a sewerage system.

The city engineer of Reading, Pa., has been ordered to make estimates for a brick and stone sewer on Bingaman street.

Contract for building a district sewer in District No. 139, Kansas City, Mo., has been let to Wm. Powell, at $56,752.05.

The contract for putting in a complete sewer system in Key West, Fla., has been let to Geo. S. Miller, of Council Bluffs, Ia.

The board of public works of New Haven, Conn., has asked for an appropriation of $176,400 for the construction of sewers.

The council of Black Rock, N. Y., has instructed the city engineer to have sewers constructed in sundry streets of that place.

The sewer commissioners of Rockville Centre, N. Y., will take action, shortly, in reference to a sewerage system for Rockaway.

The contract for sewer for Keiths' Crook district, Rockford, Ill., has been let to T. H. Walker & Co. of Kansas City, Mo., at $17,832.

An order is before the council of Boston, Mass., appropriating $50,000 for the construction of sewers at Dorchester, Lower Mills.

The council of Boston has referred to the Finance Committee an order authorizing the expenditure of $30,000 for a sewerage system.

The bid of H. C. Babbitt, of Columbus, is the lowest for the construction of the Main street sewer in Mount Vernon, Ohio, at $10,328.

Breuchard, Pennell & Co. have the contract for eleven head houses along the line of the new aqueduct, in New York City, to cost $43,512.

Col. Tilman Watson and Mayor R. H. Lawrence will commence work at once upon the construction of a sewerage system for Columbia, S. C.

The Wilmington Sewerage Company has been incorporated in Wilmington, N. C., for the purpose of constructing sewers throughout the city.

Six business men of Dowagiac, Mich., have been granted a ninety-nine year franchise for a sewer on the principal business street of that city.

The Pennsylvania Railroad Company has petitioned the council for permission to construct a sewer along its tracks in Trenton, N. J.

The city council of Des Moines, Ia., has passed resolution providing for a line of sewers along the streets known as Grand and Capital avenues.

H. H. Mitchell, of Newark, prepared the plans for an expensive sewer system for Somerville, N. J. Mall & Berry, of New York, have the contract.

Ordinance passed council in Denver, Col., creating a West Denver sewer district, No. 1, and appropriating $131,922.54 for the prosecution of the work.

The city of Gloucester, N. J., will issue $8,000 of bonds for the purpose of improving the water system and $10,000 of bonds to improve and extend the sewerage system.

A subscription list is being circulated for the construction of a sewer from Golden Gate to the bay, at Oakland, Cal. Wm. O'Neil and L. M. Boandry are both interested.

The city council of Columbus, Ga., at its next meeting, will consider the advisability of issuing bonds for the purpose of providing the city with a system of sanitary sewers.

The street and sewer commissioners of Flatbush, N. Y., have authorized the town engineer to prepare plans and specifications for sewering the principal streets of Windsor Terrace.

The board of public works at Duluth, Minn., has let the contract for the construction of a sewer in Jefferson Street, from Fourteenth avenue east to Ohio avenue, to Steel & O'Connell, for $2,290.36.

Fourteen sewer contractors, of Buffalo, N. Y., have been indicted by the grand jury of that city for an alleged conspiracy to cheat and defraud the city by a secret combination on bids for the Seneca and Michigan street sewer. The amount involved was only $5,000, though the grand jury say that $3,000 would have built the sewer. The contractors claim, on the other hand, that $5,000 is not excessive, as there is much quicksand to be handled.

WATER-WORKS.

Water-works will be built in Hurley, Wis.

New water-works will be put in at Littleton, Col.

Water-works will be constructed in Minden, Neb.

Rock Hill, S. C., is agitating the subject of water-works.

Harmonton, N. J., is agitating the subject of water-works.

A. M. Strode is building water-works at Mullen, Idaho.

Water-works are being built at Pullman, in Washington.

The Monticello, Ill., water-works will cost about $20,000.

Babylon, N. Y., has voted in favor of a water system.

There is talk of building a $25,000 water-works in Essex, Ont

A system of water-works will probably be put in at Essex, Ont.

The subject of water-works is being agitated in Liberty, Neb.

Gas mains will be laid on Tower avenue, West Superior, Wis.

Water-works will be put in at Lewiston, Idaho, at a cost of $9,000.

Water-works will be built at Antoinette, Col., at a cost of $3,000.

Lexington, Neb., has voted to issue $19,000 bonds for water-works.

Waltham, Mass., will borrow $250,000 for extending the water mains.

A system of water-works is being constructed in East Randolph, N. Y.

Babylon, N. Y., has voted to grant a franchise to some water company.

The citizens of Brookville, Ind., have voted for a system of water-works.

Smithville, Ga., will probably put in a complete system of water-works.

Montgomery, Minn., has decided to put in a $5,000 system of water-works.

Bids are wanted for the construction of water-works in Arkadolphia, Ark.

Homestead, Pa., will receive bids for the construction of a water-works plant.

The town authorities of La Harpe, Ill., have decided to put in water-works.

W. S. McMurtry, Jr., has asked a franchise for a water company at Stockton, Cal.

T. C. Johnson and M. E. Flad, of St. Louis, will erect water-works at Venice, Ill.

Contract for building the Twelfth street sewer, Port Huron, Mich., will be let this fall.

Contract for a $17,000 water-works in Toledo, Ia., has been let to George Caddoman.

Reading, Mass., will issue $100,000 of bonds for constructing a system of water-works.

C. G. Darrachand and N. L. Taylor will establish a water-works plant at Tocania, Pa.

The city council of Monticello, Ill., will build water-works which will cost $25,000.

The Hancock Water Company will considerably increase their plant in Hancock, N. Y.

A committee has been appointed to select a site for the new water system in Newark, N. J.

Bay City, Mich., will vote, this month, on issuing $50,000 bonds for water-works extensions.

The Bayard Consolidated Branch of Water Power Company has been organized at Bayard, Neb.

The recently completed water-works plant at Upper Sandusky, O., has been rejected by the council.

The city council of Lexington, Neb., has let contracts for plans for a $20,000 system of water-works.

Citizens of Aberdeen, Wash., have voted to issue $65,000 bonds for the construction of a water system.

The organization of a new company for the erection of water-works in Bellville, Ill., is being agitated.

The Ironwood Water-works Company, recently organized at Ironwood, Wis., will spend $150,000 on the system.

The Duquoin Water-Works Company will construct new water-works in Duquoin, Ill., at once at a cost of $75,000.

The Merrimac Water Company will be incorporated for the purpose of supplying Merrimac, Mass., with water.

L. N. Cox, of Washington, D. C., will receive the contract for an improved water-works system for Tarborough, N. C.

The Collingswood Water Company contemplate the establishment of a water-works system in Collingswood, N. J.

The common council, at its last meeting, appropriated $250,000 for the extension of the water mains in Boston, Mass.

The Lititz Water Company, at Lititz, Pa., will increase its capital to $25,000 for the purpose of extending their system.

The Opalika Water-Works Company has been incorporated at Opalika, Ala., with a capital stock paid up of $900,000.

Ballard, Wash., council is considering the purchase of the water-works from the West Post Improvement Company.

The council has let the contract to A. A. Richardson, of Lincoln, for a complete system of water-works in Hebron, Neb.

E. A. Ruddikor and S. J. Kennedy of Nebraska City, have secured the contract for building water-works at Hamburg, Iowa.

The Mayersville Water Company has been formed, with a capital stock of $10,000, for the purpose of supplying water to Mayersville, Pa.

W. H. Lang, Goodhue & Co. have the contract for the construction of a new water-works system at Middleboro, Vt., to cost $36,000.

The South View Water Company will be organized at Pittsburgh, Pa., with a capital of $10,000, for the purpose of erecting a water-works plant. Edward F. Hays, Thomas Miller, J. Boyd Duff and Thos. A. Noble are interested.

Filtering system may be introduced at the water works at Columbia, S. C. Jos. Green, chairman of committee. Probable cost, $25,000.

The town board of Huntington, N. Y., has authorized the organization of a local company for the purpose of erecting a water-works plant.

Engineer Kuichling, of Rochester, N. Y., is preparing estimates on the cost of procuring an additional supply of water from Lake Ontario.

Hall Brothers, the engineers, have been making observations for the erection of new water-works at Atlanta, Ga., and their report will be ready soon.

W. H. Ryan, superintendent of water-works in Salt Lake City, Utah, has asked an appropriation of $40,000 for the purchase of additional water-pipes.

A company has offered to supply water to Rutherford, N. J., on a thirty years' franchise, the water to be obtained from artesian wells or the Saddle River.

Work will be actively pushed toward the completion of the water-works system at Greenville, S. C. The American Pipe Company of Philadelphia has the contract.

The Paris Mountain Water Company has been incorporated; with a capital stock of $100,000, by Wm. S. Peert, Jr., John S. Kean, Jr., H. B. Hodge and F. M. Brooks, to construct a water system in Paris, S. C.

BRIDGES.

Scranton contemplates the erection of a costly bridge.

A new iron bridge will be built at Arkport, N. Y., at once.

A new bridge will be built over the Keowee street canal in Dayton, O.

Meriden, Ct., contemplates constructing a bridge over Harlem brook.

A company will be organized at once to construct a bridge at Atchison, Kan.

Shelton, Conn., has made an appropriation for the the erection of an iron bridge.

The Pottsville, Pa., Bridge Company has been incorporated with a capital of $25,000.

Garland & Wilson have the contract for building a wooden bridge at Port Chester, Pa.

The city council at Sherman, Tex., will issue $60,000 bonds for roads, bridges, etc.

The Union Storage Company will build a bridge over First avenue, in Pittsburgh, Pa.

The board of aldermen are considering the erection of a new iron bridge at Bridgeport, Conn.

A viaduct will probably be built over the railroad tracks on Virginia avenue, in Indianapolis.

A bridge may be built across Phalen Creek from Maine avenue to Edgerton street, St. Paul, Minn.

There is talk of building a viaduct over the railroad track at Tenth street, in Lincoln, Neb.

The Atlantic Bridge Company will widen their bridge over Smith's Creek, near Norfolk, Va.

Vicksburg, Miss., contemplates the erection of an iron bridge over Glass Bayou, at Cherry street.

The Vandalia route will join the council in erecting a viaduct over Wayne street, St. Joseph, Mich.

Work will at once be commenced upon the construction of Broadway bridge at East Albany, N. Y.

The Committee on Streets, in Portsmouth, N. H., has been authorized to obtain plans for a new bridge.

The new bridge to be built over the Union Pacific tracks at Central avenue, Cheyenne, Wyo., will cost $65,000.

The Tacoma, Olympia and Grays' Harbor will build a bridge over Union street, in Olympia, Washington.

The residents of York, Pa., are agitating the erection of a bridge over the Codorus at West College avenue.

The Great Northern Railroad will build a $400,000 bridge across the Columbia, between Portland, Ore., and Seattle.

The Middlesborough, Ky., city council has let contract for the construction of an iron bridge on Cumberland avenue over Yellow Creek, to the Youngstown Bridge Company, at $11,500.

The city engineer has the plans for a new bridge to be built at Rocksbury, Mass., over Stony Brook, at a cost of $14,500.

The commissioner of city works has been directed to construct a temporary bridge on Eighth avenue, in Brooklyn, N. Y.

The bridge across Red river, near Alexandria. La., will probably soon be built, the subscriptions having reached $27,000.

The Committee on Surveys has reported favorably on the ordinance for a bridge at Sixty-third street, in Philadelphia.

A temporary bridge, to connect Forbe street with Shenby Park, Pittsburgh, Pa., and to cost about $20,000, will be built.

Contract for the substructure of the iron bridge at Convent street, San Antonio, Texas, has been let to P. Walsh & Co.

The Road Board, of Orange, N. J., has instructed the Engineer to prepare plans for a bridge over Bloomfield avenue.

The contract for the new bridge at Spring Valley, Ill., has been let to the Milwaukee Bridge and Iron Company at $21,926.

Barton & Land have asked permission to build a viaduct from the terminus of First street to Barton Heights in Richmond, Va.

The common council at Boston, Mass., at its last meeting, appropriated the sum of $35,000 for rebuilding Ferdinand street bridge.

The contract for building an iron bridge over the Augusta canal at Augusta, Ga., has been let to G. H. Craft, of Atlanta, for $11,800.

The contract of the superstructure of the Sixth street bridge at St. Paul, Minn., has been let to the Chicago Forge and Bolt Company, at $108,875.

The West Haven and Fairfield county commissioners have voted to build a $60,000 bridge over the Housatonic river between Birmingham and Shelton.

The council at Manchester, Va., has authorized the issuing of $50,000 of bonds to construct culverts, and has also appropriated $50,000 to repair the free bridge.

The New York Central Railroad Company has been petitioned to construct a passageway under the viaduct at One Hundred and Fourteenth street, New York City.

A new bridge is to be built across the Calumet river at ninty-fifth street, Chicago, Ill. It is to be a Howe truss swing bridge, span two hundred feet, to cost $25,000.

City engineer A. H. Davidson has prepared plans for a wrought-iron bridge to be erected in Augusta, Ga., over the canal on upper Broad street, by Geo. H. Crafts & Co.

A resolution is before the council of Bridgeport, Conn., providing for the erection of a bridge thirty-five feet in width, at the North Avenue crossing of the Housatonic railroad.

The wooden bridge across Thirty-fifth street, at Chicago, Ill., has been condemned, and the cost for a new iron one has been estimated at $12,200 for the superstructure, and $11,400 for the substructure.

An ordinance was introduced at the last meeting of the common council in Harrisburg, Pa., for the purpose of increasing the city indebtedness $65,000, for the erection of an overhead bridge at Mulberry street.

A number of petitions are before the board of alderman of New York city, providing for the construction of bridges across the track of the New York Central and Hudson River railroad tracks at One Hundred and Fourteenth and One Hundred and Fifteenth streets.

STREET LIGHTING.

Shenandoah, Iowa, wants electric lights.
White Cloud, Mich., wants electric lights.
Pinckneyville, Ill., is to have electric lights.
Berlin, Wis., will soon have electric lights.
Piedmont, Ala., will be lighted with electricity.
Hastings, Mich., is soon to be lighted by electricity.
Luray, Va., is agitating the subject of electric lights.
Electric light is being agitated in Holmes City, Ohio.

Pana, Iowa, has voted to put in an electric light plant.

Pipestone, Minn., will light its streets with electricity.

Portland, Mich., will probably be lighted with electricity.

Hastings, Mich., will soon be lighte i by electricity.

Berlin, Wis., has given a ten year electric light franchise.

Weedsport, N. Y., is agitating the subject of electric lights.

The streets of Schuyler, Neb., will be lighted by electricity.

An electric light company is being organized in Spencer, Ia.

Bids will be advertised for lighting Bloomington, Ill., at once.

An electric light plant is about to be established in Windor, Mich.

Dawson, Ga., has contracted for lighting the streets by electricity.

Cleveland, Tenn., offers a franchise to any electric light company.

Contract has been let for an electric light plant in Henrietta, Tex.

An electric light plant will probably be constructed in Woodburn, Ore.

A system of electric lights will probably be put in at Covington, Ga.

Another electric light company is endeavoring to locate in Carrollton, Mo.

Efforts are being made to establish an electric light system in Greeley, Colo.

The question of lighting Littleton, Colo., with electricity, is being agitated.

Stevens' Point, Wis., will vote upon purchasing a $10,000 electric light plant.

Work has commenced on the new electric light plant in South Omaha, Neb.

The electric light plant at Parkio, Mo., will probably be doubled in capacity.

The Thompson-Houston electric light system will be introduced in Alpena, Mich.

A movement is on foot in Dallas, Ore., to put in a municipal electric light plant.

Water Valley, Miss., has voted $10,000 bonds for lighting the city with electricity.

G. A. Nieman has been granted a franchise for an electric light plant in Venice, Ill.

The citizens of Bloomington, Ill., will ask for bids for lighting their streets at once.

An electric light company will put in incandescent lights at once at New Albany, Ind.

Bids will soon be advertised for lighting the entire city of Louisville with electricity.

Frank Sprague, of Centralia, has asked for an electric light franchise in Chehalis, Wash.

The citizens of Yankton, S. D., have petitioned the city council to restore the electric lights.

J. J. Ryan will begin at once the erection of an electric light plant in South Chester, Pa.

Mystic, Conn., is agitating the subject of electric lights, and estimates for a plant are wanted.

Work will be commenced at once upon the construction of an electric plant at Havana, N. Y.

Herkimer, N. Y., has voted to appropriate $10,000 for the establishment of an electric light plant.

The citizens of Stevens Point, Wis., have voted to issue bonds for putting in an electric light plant.

Contracts will be let to the Thompson-Houston Company for an electric light plant in Lacon, Ill.

Work will at once be commenced upon the construction of an electric light plant in Glasgow, Va.

A company has been formed for the purpose of establishing an electric light plant in Wellsburg, Va.

The council is considering a proposition to light the streets of Saratoga Springs, N. Y., by electricity.

The council at Cambridge, O., has refused the offer of the Cambridge Electric Light Company to light a street for $64.50 per light. They also refuse to purchase the plant at $8,500.

Work will be commenced at once upon the construction of an electric light plant at Florence, S. C.

The Gate City Electric Company has been granted franchise for an electric light plant, at Keokuk, Iowa.

The subject of electric lights has been brought up in Grenada, Miss., and will be settled by special election.

Holland, Mich., is to be provided with an electric light plant, and arc lights are to be used on the streets.

At the coming election Granville, N. Y., will vote upon the question of electricity for lighting the streets.

At Ames, Ia., the Ames Street Car and Electric Motor Company has been granted a franchise for electric lighting.

The Beardstown Electric Light and Power Company will put in an incandescent plant at Beardstown, Ill.

The Westinghouse Electric Light Company has been awarded the contract for lighting Summit, N. J., by electricity.

The Helena, Mont., Electric Company has taken out a permit for an electric light and power house to cost $10,000.

The Richmond Light, Heat and Power Company, will establish an electric light plant at New Dorp, N. Y., at once.

An election will be held in Herkimer, N. Y., shortly to decide whether the village will construct an electric light plant.

The council has voted to let the contract for lighting West Bay City, Mich., the coming year to the Home Electrical Company.

Peabody, Mass., contemplates the immediate erection of an electric light plant sufficient to supply the city and private consumers.

The borough has signed a contract with the Edison Electric Light Company for lighting the streets of Plainfield, N. J., by electricity.

The National Electric Light Company, of Milwaukee, Wis., has been awarded the contract for an electric light plant for Chester, S. C.

A syndicate of New York capitalists has secured the franchise for the construction and operation of an electric light plant in Racine, Wis.

An ordinance has passed council granting to Ludolph P. Martin, the right to light South Denver, Colo., with electricity for twenty years.

There are eight electric light companies operating independently in Cincinnati, O., and the city is contemplating putting the wires underground.

The South Denver Light and Power Company has been incorporated, with a capital stock of $80,000, to furnish South Denver, Colo., electric lights.

The Lincoln Gas Company and the Lincoln Electric Light Company, of Lincoln, Neb., have consolidated their business under one management.

A committee of the common council at Doylestown, Pa., are investigating the various electric light systems, with a view to their adoption for that city.

Frank Sprague, of Centralia, has asked twenty-five years franchise for electric lights in Tacoma, Wash., as have also J. R. Bolty and Messrs. Donahue and Kauffman.

The Board of Trade has authorized the executive committee to confer with the various electric light companies regarding the establishment of a plant in Darlington, S. C.

Merchants of New Orleans, believing that they paid exhorbitant prices for electric lights, have formed the Consumers' Electric Light Company, and asked franchise for plant.

The council of New Orleans has been petitioned strongly for the substitution of electric lights for gas lamps, and the Louisiana Electric Light Company has made a proposition.

At the last meeting of the council a committee was appointed to secure plans and estimates for lighting the streets of Columbus, Ga., by electricity, and to report at its next meeting.

The citizens or Shamokin, Pa., have formed an electric light company, and appointed a committee to investigate the different systems, with a view of their adoption in that city.

Independence, Kan., will vote upon granting a five years' franchise for lighting streets with twenty-three electric lights.

Work will immediately be commenced in Charleston, S. C., upon the construction of the Electric Light Company's new works.

The charter of the Frederick Lime Company of Frederick, Md., just incorporated with a capital of $50,000, empowers it to erect and operate telegraph, telephone and electric light lines.

There is talk at Richmond, Va., of the city to own its electric light plant. Bids for lighting the city with electricity will be advertised at once for a period of twelve months from February 8, 1891.

The mayor of Baltimore, Md., in his next annual message to the council, will recommend the purchase of the present electric light plant and the establishment of a new system, to be operated by the city.

The Los Angeles Electric Light Company has been awarded the contract for lighting Los Angeles for two years. There is also an ordinance before the city council granting a fifty year franchise to the Los Angeles Electric Company.

CHAS. A. NICOLI
WOOD AND PHOTO
ENGRAVER.
21 & 23 HUBBARD BLK. Indianapolis, Ind.

FOR LICENSES

To Manufacture Trinidad Asphalt Paving Blocks and Tiles and Guaranteed Supply of Asphalt, complete plans for Buildings, etc., apply to

WALTER S. WILKINSON,
President International Pavement Co.
5 Chamber of Commerce, BALTIMORE, MD.

THOS. R. HASLEY,
CIVIL ENGINEER
Surveys, Plans and Specifications for Sewerage and Drainage, Special Attention paid to Paving and General City Improvement. Expert City Surveying, Detail City Maps, Grade Atlases, Construction Superintended.
Main Office at Marinette, Wisconsin.

Geo. A. Latimer,
City Civil Engineer
Norfolk, Nebraska.
Plain Surveys of Cities and Towns. Designs and estimates for water supply and sewerage systems. Public works superintended.

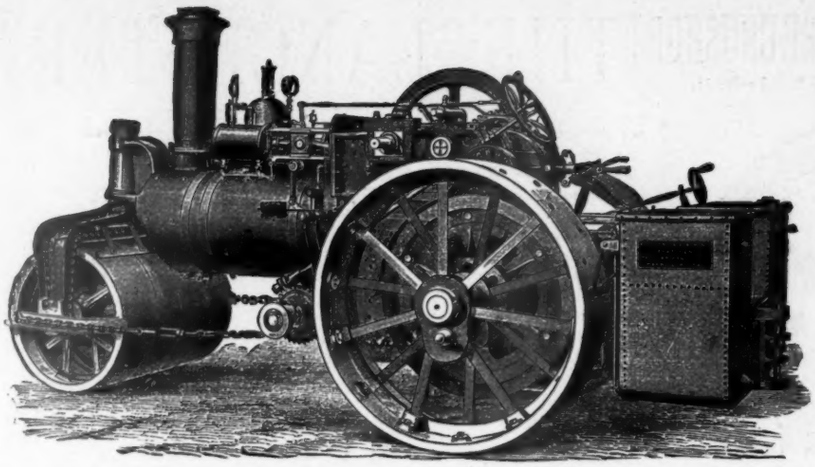
J. OPPERMAN,
Civil and Consulting Engineer
25 YEARS EXPERIENCE.
Railroad Engineering, Water Supply and Sewerage of Towns, Assessment Maps, Street Paving, Electrical Subways, Examinations, Surveys, Maps, Plans, Specifications, Estimates and Reports.
Room 112 Laclede Building, ST. LOUIS, MO.
Correspondence Solicited.

C. ALEXANDER, C. E. Mem. Can. Soc. C. E. Mem. West. Soc. C. E.
FREMONT HILL, C. E. Mem West. Soc. C. E.
ALEXANDER & HILL,
Civil Engineers
Plans and Specifications furnished for all classes of Engineering Work. Specialists on Street Paving Sewer Construction and Municipal Work generally
ROOM 6, No. 78 LA SALLE STREET,
Chicago, Ill.

W. L. S. BAYLEY, C. E.
Durability, Style and Economy in the Construction of
STREETS, ROADS AND LAWNS.
ESTIMATES AND DESIGNS.
Office, 8 Lakeside Building, Residence, 324 44th Street, • CHICAGO.

YOU WILL MAKE NO MISTAKE
IF YOU CONTEMPLATE A TRIP TO
Chicago, Milwaukee, St. Paul, Minneapolis, or any Northwestern Point,
By purchasing your tickets over the
MONON * ROUTE
L. N. A. & C. R'Y.
The New Management having entirely rebuilt the line, putting in over 300,000 new ties, miles of new steel, new iron bridges, etc., etc. This, in connection with elegant Pullman Perfected Safety Vestibule Trains, composed of DAY COACHES, PARLOR and DINING CARS (the only line running Dining Cars between Indianapolis and Chicago), and Pullman Buffett Sleepers, makes this
THE LINE between Indianapolis and Chicago, also the Short Line, only 183 Miles Indianapolis to Chicago.
Be sure and purchase your tickets via the
GREAT MONON ROUTE.
Ticket Offices, 26 South Illinois Street, Massachusetts Avenue and Union Station.
JAMES BARKER, G. P. A., Chicago.
I. D. BALDWIN, D. P. A., Indianapolis

THE PURINGTON PAVING BRICK COMPANY
OF GALESBURG, ILLINOIS,
Is now building one of the most extensive and best equipped plants ever established for the manufacture of Paving Brick. D. V. Purington, of Chicago, is President of the Company. Mr. Purington is one of the foremost Brick Makers in the country. With a quarter of a century experience he has a thorough knowledge of the merits of the various DRYERS. HE HAS SELECTED FOR HIS NEW WORKS
*****THE IRON-CLAD DRYER*****
This Dryer will have a Drying Capacity of SEVENTY-FIVE THOUSAND per day. Mr. Purington's selection is another evidence of the established fact that for
PAVING BRICK NO OTHER DRYER COMPARES
WITH THE IRON-CLAD DRYER
For particulars see advertisement on last page of cover, and write to
THE IRON-CLAD DRYER CO., CHICAGO, ILL.



THE HARRISBURG PATENT

DOUBLE ENGINE STEEL

Steam Road Roller

Constructed of the Best Quality of Material Throughout Guaranteed Equal to any

ROLLER IN THE MARKET.

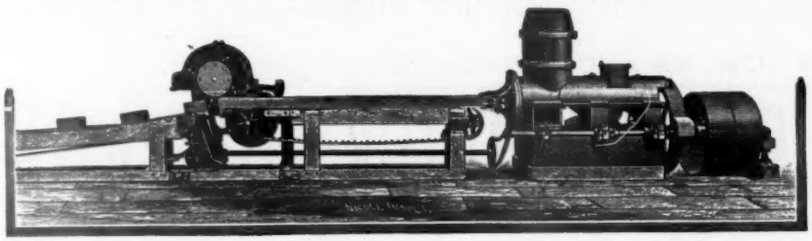
MANUFACTURED BY

Foundry and Machine Department,

HARRISBURG, PA.

SEND FOR CATALOGUE.

THE * LITTLE * WONDER * BRICK * MACHINE



And Cunningham's Automatic

Cutting Table

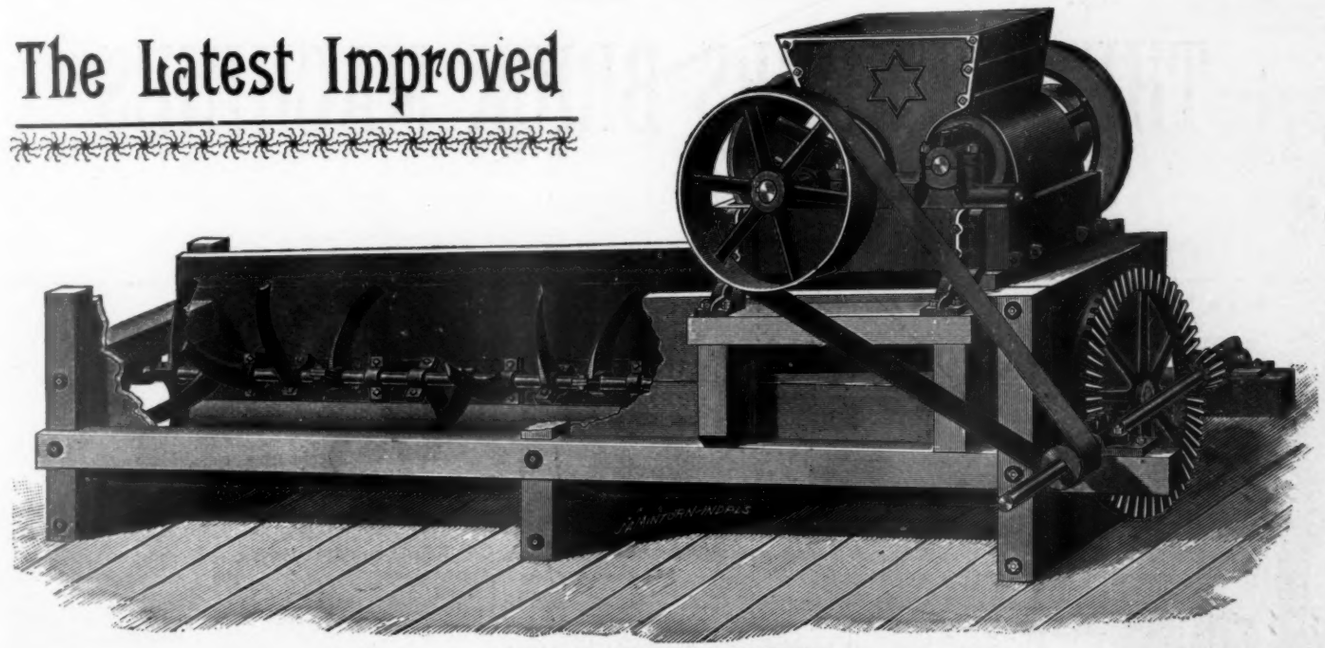
Send for Illustrated Catalogue.

Mention this Paper.

The Wallace Manufacturing Comp'y

FRANKFORT, INDIANA, U. S. A.

The Latest Improved



COMBINED PUG MILL AND DISINTEGRATOR.

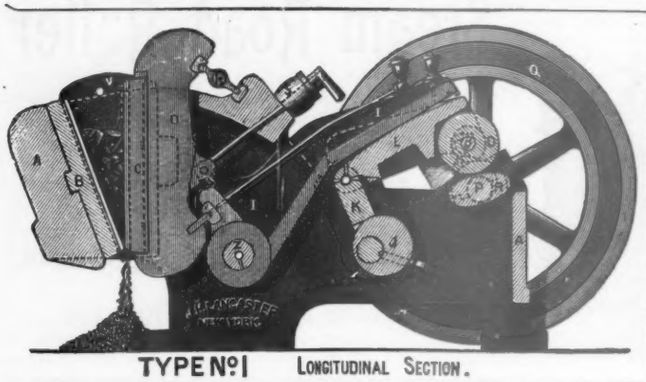
Brick & Clay Working Machinery

We are prepared to erect complete plants of any desired capacity, and keep in stock a full line of BRICK MACHINERY, PUG MILLS, DISINTEGRATORS, Mold Sanders, Clay Cars, Drums and all kinds of Brick-makers' Supplies furnished on short notice. Write for 1890 Catalogue.

C. & A. POTTS & CO., INDIANAPOLIS, IND.

THE LANCASTER ROCK BREAKER AND ORE CRUSHER

The Strongest, Simplest, Cheapest and the Most Perfect Rock Breaker Made.



TYPE No. I LONGITUDINAL SECTION.

Adjustable while running to instantly yield any desired uniform grades of product.
Half the power only required and is less liable to breakage, and less in first cost and also in subsequent wear and tear, and less weight than any rival's breaker. For crushing rock for concrete these breakers are specially efficient.
The "Lancaster" Crushers are also made in "Sections" for easy transportation in mountainous regions. May be mounted on wheels, worked by hand, horse gear and steam or other power, and also fitted with Rotary Screens, Elevators and Conveyors. Correspondence and trial tests solicited.

THE "LANCASTER"

Will automatically dig, raise and discharge minerals, such as mud, clay, gravel, sand, hard pan, ores, rock phosphates and fire-clay from their beds and banks, and also load and unload vessels or barges with sand, coal ores, grain and other materials. These Grapples are made of best forged steel, with four penetrating scoops, operated solely by compound leverage, thus dispensing with the inside sheaves, drums, catches, gears, chains and friction, found in all rival buckets. They may be worked by hand or horse-power, or by any maker's double drum hoisting engines.

Send for our new illustrated price-list, agency terms and testimonials, and make appointment to see our Rock Breakers, Grapples, Hand, Horse and Steam Power Hoisters at work. Comparison of our prices, capacities and merits with all rival Grapples, Rock Breakers, Hoisters, Etc., earnestly solicited. Licenses to manufacture granted.

Correspondence solicited. Manufactured and sold by the patentee.

Self-Penetrating Grapple, Excavator and Dredger

JAMES H. LANCASTER, (P. O. BOX 3139) 169 AND 171 BROADWAY, NEW YORK, U. S. A.

THE PURINGTON PAVING BRICK COMPANY

OF GALESBURG, ILLINOIS,

Is now building one of the most extensive and best equipped plants ever established for the manufacture of Paving Brick.
Mr. D. V. Purington of Chicago, the President of the Company, is one of the foremost brick makers in the country.
With his long experience and knowledge of the art he has selected for his new works

THE CHAMBERS BRICK MACHINES

IN HIS IRON CLAD DRYER HE WILL USE CHAMBERS'S WROUGHT BODY DRYER CARS.

It Pays to Buy the Best. See Advertisement on Last Page of Cover.

FOR MAKING ROAD METAL USE THE

GATES ROCK AND ORE BREAKER

OVER **2000** IN USE.

CAPACITY IN TONS OF 2,000 POUNDS.

Size 0	2 to 4 tons per hour.	Size 4	15 to 30 tons per hour.
Size 1	4 to 8 tons per hour.	Size 5	25 to 40 tons per hour.
Size 2	6 to 12 tons per hour.	Size 6	30 to 60 tons per hour.
Size 3	10 to 20 tons per hour.	Size 7	40 to 75 tons per hour.
		Size 8	100 to 150 tons per hour.

Passing 2 1-2 in. ring, according to character and hardness of metal.

Great Saving in Power. Adjustable to any Degree of Fineness. The principle involved in this Breaker acknowledged to be the greatest success ever introduced into Stonebreaking machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of breakers combined. **Universally Adopted by Mining Companies. Many Hundreds Used by Railway Companies.** Will furnish a thousand references from Contractors, Street Superintendents, Mines, Cement Manufacturers, etc. Also Manufacture

THE CORNISH ROLLS PULVERIZER

Fine Crushing Plants, Concentrators and Other Mining Machinery. Address for Catalogue

73a Queen Victoria St., LONDON.
44 Dey St., NEW YORK.
215 Franklin St., BOSTON, MASS.

Gates Iron Works, 50 R S. Clinton St., Chicago.

THE INDIANAPOLIS * * *

Paving Exposition

ALL cities in the United States are invited to send committees or official delegations to Indianapolis to avail themselves of the unequaled advantages afforded by the Exposition for gathering knowledge of paving.

EMBRACING

The Largest and Finest Collection of Specimens of Paving

IN THE WORLD,

WILL, on account of its value and beneficial influence in STIMULATING A SPIRIT OF PUBLIC IMPROVEMENT, be continued indefinitely under the management of the Commercial Club of Indianapolis, the organization which originated the idea and made the Exposition a success.

Exhibits of More than Sixty of the Leading American Paving Companies.

New exhibits are being added, and the Exposition will be enlarged and improved in every way possible. Companies not already represented are invited to send exhibits, but no paving material regarded by the committee in charge as being without merit will be admitted to the Exposition. Exhibits must, in all cases, be shipped with freight charges prepaid.

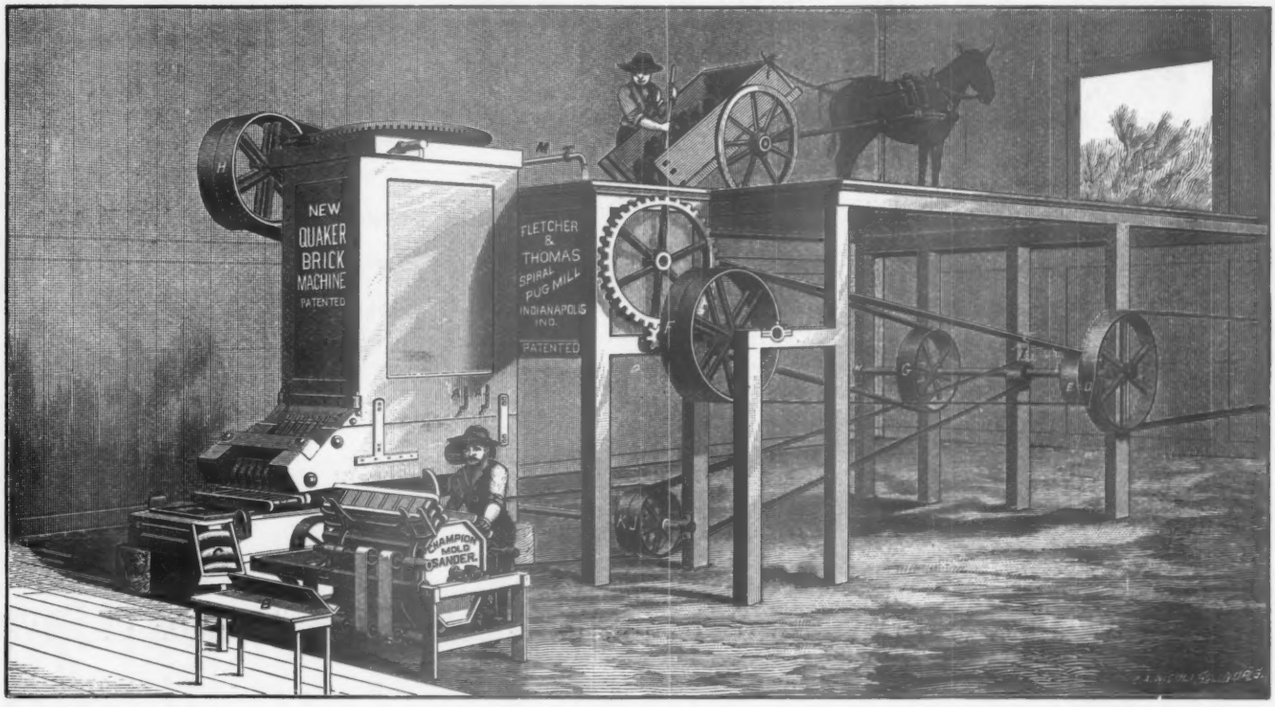
The assurance can be given that more can be learned about paving at this Exposition than by visiting a dozen of the best paved cities in America.

A two-cent stamp should be sent with requests for copies of the REPORT OF THE PAVING EXPOSITION.

For further information, address the Commercial Club, Indianapolis, Indiana.

M. S. HUEY,
GEO. N. CATTERSON,
WILLIAM C. BOBBS,
Paving Exposition Committee

FLETCHER & THOMAS



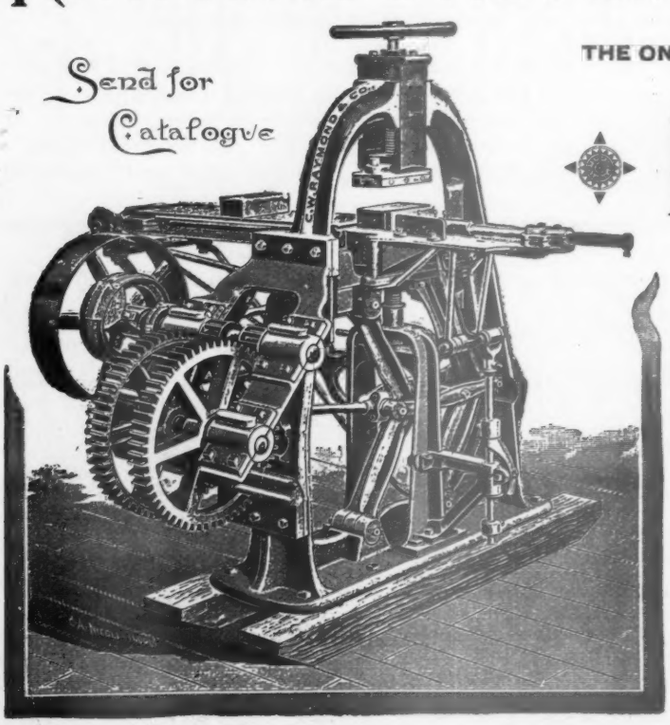
Improved Brick-Making Machinery

The above cut represents the New Quaker Complete Combined Steam Power Outfit. Capacity, 40,000 per day. Capacity of Horse-Power, 15,000 to 20,000. The most most perfect machinery for making PAVING BRICKS, FIRE BRICKS or COMMON BRICKS. We make a specialty of equipping yards complete in every detail ready for work. Send for illustrated catalogue.

Correspondence Solicited. **FLETCHER & THOMAS, INDIANAPOLIS, INDIANA.**

RAYMOND'S AUTOMATIC POWER PRESS

Send for Catalogue



THE ONLY SUCCESSFUL RE-PRESS FOR MAKING

PAVING BLOCKS

RED AND FIRE BRICK, ROOFING TILE, ETC.

A rapid working and powerful machine for pressing paving blocks, by which they are given great density and uniformity of size and finish. Make from 8 to 12 thousand finished paving blocks per day. No first-class paving brick made without re-pressing.

Dumping Cars, Portable Track,
Dryer Cars, Transfer Cars
and General Brick Yard Supplies.

C. W. Raymond & Co., Dayton, Ohio.